



FRIDAY, JANUARY 17, 1879.

## Report of the Government Directors of the Union Pacific Railroad.

BOSTON, Dec. 7, 1878.

HON. CARL SCHURZ, Secretary of the Interior, Washington:

SIR: With the exception of a single one of their number (Mr. Chadwick, of Connecticut, who was originally made a member of the board in March, 1877), all of the present government directors of the Union Pacific Railroad were appointed within the present year. They none of them had any previous knowledge of the affairs of the corporation, or were more than generally informed as to its relations with the government. Under these circumstances, it was fortunate that, very shortly after their appointment was decided upon, two acts of Congress were passed which greatly simplified their work. By one of these acts the annual payments, allowances, etc., to be made to the government by the Union Pacific were fixed; while by the other a new bureau was established, in connection with the Department of the Interior, for auditing the accounts of that company among others. These two measures of legislation effectually relieved the present government directors from further considering many subjects which had engaged the attention of their predecessors. For the immediate time being, and at least pending the action of the courts in cases arising out of the operation of the acts referred to, and which are now, it is understood, ready for decision, the financial relations of the government and the Union Pacific must be considered as definitely settled. This subject therefore calls for no further discussion. As respects also the condition of the company's finances, its resources and the disposition made of them, the government has its own auditor, and is in immediate possession of all the facts and statistics which it would be in the power of government directors to furnish. Neither have the present directors thought it incumbent upon them to further investigate questions of the past connected with the construction of the Union Pacific road or its earlier operations. They have, on the contrary, deemed that they would best subserve the purpose of their appointment by strictly confining their attention to questions of the present; giving the Department such information as they might be able to procure relating to the existing condition of the property, and the policy now pursued by the direction in the management of the company's affairs.

The usual yearly inspection of the road was made in September and October last. All of the members of the board took part in it, with the exception of Mr. Chadwick, who was prevented from so doing by business engagements. He, therefore, does not join in that portion of the report derived from personal observation of the property or its management on the spot. Both locally upon the line and in the general offices of the corporation at New York and Boston, every facility has at all times been afforded the directors toward obtaining whatever information they may have desired. No disposition to withhold or conceal has at any time been apparent. On the contrary, from the beginning, the fullest investigation seemed rather to be courted; while more than once the feeling has been openly expressed that justice has not been done either to the actions or intentions of those now responsible for the management of the company's affairs. A public inquiry, at once impartial and intelligent, could, it was claimed, result only to its advantage.

So far as the inquiries of the present government directors have gone, they have been of a general character and have related solely to the two subjects already referred to; the material condition of the property, and the business policy of those managing it: as respects these also, the inquiry has necessarily been both partial and superficial. The conclusions arrived at, so far as they go, are in many respects quite different from what the directors anticipated when the inquiry was begun. Such as they are, however, they could not be avoided.

## MATERIAL CONDITION OF THE ROAD.

In passing upon the material condition of the Union Pacific Railroad, the first point to be determined is the standard by which it shall be judged—whether by that in use on the eastern trunk lines, or by that in use on the best roads of the Mississippi valley, or by the less severe standard which is usually applied to the new roads west of the Missouri. In view of the facts, which it is unnecessary to more than refer to, connected with its organization and construction, it seems manifestly right that the Union Pacific should be judged by the most severe standards known among the railroads of the country. No good reason is apparent why it should not be held strictly to this test, or why its owners and officers should object to it. As is matter of common knowledge, the road was practically built out of the public money, and the stock, which now represents its ownership, represents little besides the enterprise and energy which the original constructors put into their undertaking. The corporation, on the other hand, received from the government an endowment of unprecedented liberality. The road was designed to be a great national thoroughfare—a monument of public liberality and of private enterprise. Under these circumstances those representing the government in the conduct of its affairs would clearly not be justified if in their inspection they applied any standards short of the highest known to the railroad system of the country. Especially would this be so, when, as in this case, the road, as a commercial enterprise, has proved a brilliant success: when its annual gross earnings, falling but little short of thirteen millions of dollars, are the largest, with five exceptions only, in our whole railroad system. Neither are those earnings peculiarly absorbed in the necessary operation of the road. On the contrary, while but three companies only in the country—the New York Central & Hudson River, the Pennsylvania and the Central Pacific—report larger annual net proceeds, the percentage of operating expenses to gross receipts (42 per cent.) has, during the last three years, averaged lower with the Union Pacific than with any other great railroad company without exception. These facts are referred to in this connection, not to prejudice the corporation, but simply to fix beyond a question the character of the standard which should be applied to its road.

In applying that standard, however, the directors have endeavored to bear continually in mind the peculiar conditions of climate, soil, traffic and population under which the Union Pacific is operated. While in many respects most favorably placed for economical working, that railroad is also subject to natural laws which seem peculiar to itself. For instance, the line was originally laid out and the road was constructed rather, it would seem, to save time and money, and to earn a mileage subsidy, than with any regard to what are considered sound engineering rules. It was a surface road, in which cuts and embankments were carefully

avoided, without regard to curvature or undulation of track. As the subsidy was paid by the mile, such a method of construction, while it saved money on the one hand, earned it on the other. In gradually converting this original structure into a first-class permanent work, it would naturally be expected, according to all established precedent, that the alignments would be rectified, the embankments made higher, and the cuts deeper, while the surface undulations would have been reduced to grade. Experience, however, has shown that, whether sagaciously designed or otherwise, the original construction was for this particular road the best construction possible. It has enabled the trackmen to contend successfully with the clouds of fine, dry snow which drift in winter over the plains, filling every cut, but blowing clear of all embankments. Accordingly, the whole tendency of the company in the renewal of its road-bed has been to seek the shoulders of the hills by curves and undulations, instead of going through them on straight lines at an even grade. The effort is to keep the track at all points slightly elevated above the country through which it runs.

So, again, as respects mason work. In the usual process of first-class railroad renewal, the gradual substitution of stone for trestles and piling is assumed as a matter of course. The Union Pacific, as regards certain large portions of its line, seems to be an exception to this rule. In many places the company is now even taking out original mason work of a fair order and replacing it with piling. This, too, is done because experience has shown that in their soil and with the climatic conditions under which they work, masonry is far more liable to wash-outs than piling. The annual rain-fall is not large, but at times it comes in torrents. No ordinary provision is then adequate for the water's escape, and where the surface of the soil has been broken to put in mason work, without carrying its foundations down to bed-rock, the superstructure is peculiarly liable to be undermined and swept away.

The same climatic conditions, on the other hand, affect the road most favorably as respects its economical operation. The character of the soil and its freedom from water obviate the great difficulty of frost, against which the Eastern roads are forced to unceasingly contend. On very large portions of the Union Pacific, the directors were assured that the track and road-bed came each spring out of the winter in much the same condition, apart from regular wear, in which they went into it. The soil neither heaves nor washes. This again immediately affects the life of rails and ties, as well as the condition of the rolling-stock. Indeed, cottonwood ties were pointed out which had apparently been in the track since the original construction of the road ten years ago, and which were still in good order.

As respects fuel, ballast and building material, except wood, the Union Pacific, as compared with the generality of Eastern roads, is most advantageously placed. Contrary to all expectation, and again in apparent defiance of experience, the native soil thrown up from the road side during the process of original construction, has, on a large portion of the line, proved itself a ballasting material of the best description. Dry, elastic, and easily handled, it calls for no foreign admixture, and would hardly be improved by it. For only 230 miles of the entire line, or but 22 per cent. of the whole, is foreign ballast ever deemed necessary. So also as respects fuel and building material. They are found in great plenty and of the best description directly on the line of the road, although in many cases a long haul is required to get them where they are needed. Yet this haul is in every case wholly over the company's own rails, and for it they can use their own returning rolling stock at their own convenience. Practically its cost is thus reduced to a minimum.

In the matter of grades, also, the line is, considering the elevation necessarily to be overcome, most fortunately circumstanced. The whole eastern half of it, a distance of more than 500 miles, is a gently ascending western grade, averaging 10 feet to the mile; while the heavy grades of the mountain divisions are limited to three localities, respectively of 50, 60 and 80 miles in extent, in which 90 feet to the mile is the maximum, and that at one point only. Of the entire 1,086 miles of the road over 800 are most easy of operation; nor is this all. The overcoming of grades is, of course, a mere question of power. In the case of the Union Pacific the grade and the power which overcomes it are met together. As the coal mines are in the mountain divisions, allowing for the difference between the value of the coal at the mouth of the mine (\$1.13) and in Omaha (\$7.50), it would actually seem to cost the Union Pacific but a trifling amount more to haul its trains over the mountain west of Cheyenne than it does to haul them over the plains east of that point.

As respects water and the price of labor, the company operates its road at certain points at a serious disadvantage. Indeed, in the Western divisions, the absence of good water is probably more seriously felt than the presence of the grades. In the matter of snow, on the other hand, the difficulties originally apprehended have been, to a great extent, overcome, and the expenses reduced until they are no longer material. The officers have learned how to deal with it; and, during the past three years the entire cost of removing ice and snow, including the repairs of sheds and fences, has added hardly 1 cent per mile to the expense of running trains.

In passing upon the material condition of the line, it should also be borne in mind that in the traffic which the Union Pacific is called upon to accommodate, there is little which requires frequent or expensive handling. That is, the business, both freight and passenger, through and local, whether originating and ending on the line of the road or not, is usually carried long distances, so that none of the complicated movement and frequent interchange of trains is required, which is usual on Eastern roads. This, of course, necessitates no such elaborate and costly arrangement of tracks, sidings, yards, buildings and general appliances as is found upon roads with much smaller traffic in other portions of the country. These need not, therefore, be looked for. The Union Pacific at present requires only those accommodations necessary for doing a business of the simplest known character.

Taking all these things into consideration, and making full allowance for them, the directors are unable to say that the present condition of the Union Pacific road is in all respects satisfactory. On the contrary, when measured by the standard which has been suggested, its deficiencies are many and apparent. The policy as respects the completion and renewal of its road which the company apparently has pursued, and now is pursuing, might, perhaps, if judged by the test of strict business principles in the shrewd management of a practical monopoly, be deemed a fairly liberal one. In making their examinations, it is true, the present directors labored under the great difficulty of having no previous knowledge upon which to base a comparison, but it is nevertheless sufficiently obvious that the property, instead of deteriorating, is being brought up with steadiness, though slowly, to a fair degree of average excellence. It is still, however, far short of what with its original endowment and large present earnings it ought to be, and very far short in almost every respect of that high standard of excellence, both in scope and in detail, to which those familiar with the great trunk lines of the country are now accustomed.

## THE OPERATING MANAGEMENT.

As regards the local management, the directors are not sufficiently acquainted with those who compose it to offer

any criticism of value. The officers are doubtless competent, energetic and faithful; as, unquestionably, they are experienced. There is, however, nothing in the present shape of the organization, as regards division of labor and study of detail, which would indicate that it is the work of any superior organizing mind. It gives rather the impression of being simple even to crudeness, and quite lacking in system. This absence of thorough organization is very apparent whenever results are examined in detail. On the road itself, for instance, it is evident that the standard of excellence, where it has been established at all, has not been fixed high enough or rigidly insisted upon. It is true that the Union Pacific has always been operated and renewed under circumstances unfavorable at least to its thorough reorganization. Its ownership has more than once changed; and, as is well known, it has at times been in hands more solicitous as to movements of the stock market than honestly desirous of attaining even material excellence. The local management has accordingly never been the responsible management; nor, however good or comprehensive its ideas may have been, has it ever occupied a position which would have enabled it to carry them out. Meanwhile it is obvious that no system whatever has been pursued in filling up the subordinate situations. As vacancies occurred officers have come to the road from all sections of the country, and have brought with them theories and methods which are far from uniform. The result is that there is no apparent uniformity of work. While the individual division superintendents and road-masters appeared efficient and faithful, they did not recognize the same standards, nor, it was obvious, did they in many cases have any conception of what the highest standards were.

This singular absence of system appeared throughout, and in matters well calculated to excite surprise. The directors, for instance, were unable to obtain any profile or detailed map of the road to aid them in their examinations. To satisfactorily inspect a road without this, or a considerable previous familiarity with it, is of course impracticable; and yet it appeared that, if such documents ever existed, they had been destroyed and had not yet been replaced. So also as respects mile-posts: if the Union Pacific ever has been divided off, except by section-posts, the miles have long since disappeared, so that it is now extremely difficult to locate anything upon its line except by stations and bridges. The unfortunate absence of standards is, however, most apparent in the motive power and track of the company. For this, of course, the present management is but partially responsible, and it is using its efforts to reduce the existing chaos into something like order. This, however, will require time. Locomotives and rails which are still good cannot, of course, be discarded, because unfortunately they were purchased of every possible pattern in the early days of the enterprise.

## CONDITION OF BUILDINGS, SHOPS, BRIDGES, EQUIPMENT AND RAILS.

Passing further into detail, the directors found the general offices of the corporation at Omaha, the new depot building at Council Bluffs and the several round-houses at the division centres, all excellent structures and creditable to the company. This cannot be said of the stations and other buildings on the line, even those at the converging or central points, like Ogden, Cheyenne, Kearney and Omaha. Originally cheap and temporary, the structures at these points have deteriorated with time and use. Large and expensive renewals in this respect should already have been made, and cannot much longer be deferred.

The general repair shops of the company at Omaha may originally have been laid out upon a convenient plan, but if so, it was one which unfortunately did not admit of extension.

Accordingly, as the requirements of the company have increased these shops have become inconvenient, and their reconstruction on a larger scale would seem to be a mere question of time. The division shops, on the other hand, as well as the rolling mills at Laramie, seem to have been well designed, and are amply sufficient for all requirements, both present and future. Judging by a very superficial examination, and the results as seen through the returns, the shops seem to be well and skillfully managed and open to no criticism.

The road seems to be liberally equipped with rolling stock, which is apparently kept in very good order. There is a great abundance of excellent motive power, though the locomotives are of a number of different patterns. Indeed, this department of the company's service, perhaps more than any other, reflects credit upon it.

As respects its bridges, the company seems to be pursuing a systematic and sufficiently liberal policy of renewals. The original structures have lasted remarkably well. The larger wooden truss bridges are now being replaced by iron; and the trestle and pile bridging, where it could not be gotten rid of by embankments, seems to be kept in thorough repair. For reasons which have already been referred to, the substitution of mason-work for piling in the smaller bridges and culverts does not form a part of the company's policy of renewals.

The road-bed is, as a whole, not yet brought up to the proper standard, as it is in many places light, narrow and low. It is, however, being rapidly lifted and improved, and it is safe to say that the work of renewal, in this respect, will more than keep pace with the renewals of iron. If the principle as respects curves, cuts, embankments and undulations upon which the road is now being operated should prove permanent, as well as correct, the bringing the road-bed up to a condition of standard excellence, including the important item of ballasting, will be a simple and inexpensive matter.

The lack of standard and system which has been remarked upon in other respects is peculiarly noticeable in the matter of ties. The road is, as a whole, very well provided with them; indeed, not infrequently they exceed the regulation number of 2,640 to the mile, and are so close together that there does not appear to have been sufficient space left between them to enable the section men to fully work the ballast. Little attention seems anywhere to have been given to the careful spacing of the ties, and if any rule in this respect was ever laid down a rigid compliance with it on the part of the road-masters has obviously not been insisted upon. This is the more noticeable as the character of the soil and absence of heavy ballasting would seem to make a careful observance of some rule in the matter peculiarly desirable. It would, however, seem that great numbers of ties have from time to time been put in the track with very little regard to their size; while none have been taken out until they were thoroughly rotted through. The spiking is not less slovenly, and there is thus an absence of symmetry and a disregard of appearance about the track, when examined in detail, which is not suggestive of a first-class railroad.

It is in the character of its rails, however, that the Union Pacific is most deficient. Considering the large income of the company and the recent low price of steel, the economy of renewals in this respect has been carried much too far. While, during the last six years, first-class roads in other parts of the country have wholly replaced their iron with steel, removing every defective rail from their tracks, the Union Pacific has thus renewed but 290 miles out of 1,036. This comparatively small portion of its track is fairly up to



standard, but the remainder can hardly be ranked as even of the second class. In it are not seldom to be found sections of track where there are rails of different pattern and of varying lengths, with joints even or broken, as the case may be, resting on chairs or spliced with plates, on the ties or suspended between the ties; rails which have been cut and turned and handled, and which are low at both joints and crushed in the centre. Nor, unfortunately, are these very exceptional. The rule is understood to be that no rails, having service in them, of over 16 feet in length are to be removed from the track, and during their inspection the directors not infrequently saw them of 12 feet in length and even less. That portions of the road can under such circumstances safely go into the winter must be due to the fortunate freedom of the soil from frost. It could not be done in the East.

In explanation of this very noticeable state of facts, it was suggested to the directors that the rails which have been referred to were a portion of the original iron of the road, which was of such a singular toughness and strength that, in spite of its battered appearance, it was still kept in the tracks for the simple reason that, even in its present condition, it was found to outlast new iron. It would hardly, however, be suggested that this original iron is in its present lamentable state superior to steel; and it is with steel that first-class roads are now equipped. The Union Pacific, moreover, as respects its iron, continues the practice, long since abandoned by solvent companies, of putting down in front of its stations the poorer rails taken up among those still having service left in them, upon the ground that, as the trains run at slow speed before the stations this description of rails can be used without danger. Judged by any standard now in use on the first-class roads of this country, no rail which is not safe to run over at speed is thought safe to keep in a main track anywhere. Certainly the careful collection of such rails in the tracks before stations indicates an utter disregard of appearances and absence of pride which should not be found in those managing a great continental thoroughfare. The directors feel that in this respect the condition of the road is open to sharp criticism, and that they would be failing in duty if they refrained from expressing it.

In conclusion, their examination has led the directors to believe that the policy now pursued by the company in regard to the material condition of the property, while careful and sufficiently safe, is by no means liberal. The impression given to an inspector is that the principles of economy are very rigidly impressed by a distant board of direction on the local management. The percentage of operating expenses to gross earnings is very closely watched. However it might be if the road were completed and brought throughout up to a first class standard, it is obvious that the percentage of operating expenses is now smaller than it should be, and the reason that it is smaller is made plainly apparent by any close inspection. The policy of the company in this respect has not been such as the country had a right to expect or the government to insist upon.

(The portion of the report which we published last week on the relations of the road to the public and to other railroads, follows here in the report.)

#### THE OMAHA BRIDGE CHARGES.

The question as to whether the legal terminus of the Union Pacific road was upon the west or the east side of the Missouri River—in Omaha or in Council Bluffs—has heretofore excited much public interest and engaged the attention of the government directors. This question was some years ago finally decided by the Supreme Court in favor of the east side of the river. (*Union Pacific R. R. Co. vs. Hall*, 1 Otto, 343). As the proceedings in this matter are of public record, and as such are accessible to the government, no further reference to it would seem to be here necessary. In accordance with this decision, the bridge across the Missouri River has become an integral portion of the through line, and the Union Pacific trains now run to the union depot at Council Bluffs. The connection with the various roads east of the river is there made.

This action of the courts would seem finally to dispose of the question of the Omaha Bridge charges, which have for years been the occasion of much public discussion, especially at Omaha. It is, however, still locally urged that the bridge allowances in the division of receipts from through business made to the Union Pacific, and the rates charged for the carriage of persons and merchandise between Council Bluffs and Omaha, are excessive, if not illegal; or, as it is usually stated, they constitute an onerous and special tax, which the corporation has no right to levy, of 50 cents a head on every person and \$1 on every ton of merchandise which crosses the Missouri on the Union Pacific tracks. So far as these complaints relate to the legality of the allowances and charges, the directors do not feel it incumbent upon them to either form or express an opinion. That question the courts must decide. So far as their propriety or reasonableness is concerned, the matter is one clearly within the province of the board. As respects through passengers or freight the allegations referred to would not appear to be sustained by facts. It is true that, in the division of receipts from through business among the connecting roads, an allowance for bridge charges is made to the Union Pacific. But it does not follow that the total amount paid, either by the passenger, or upon the goods crossing the river, is at all increased thereby. It would seem, on the contrary, to be merely another question arising out of those methods of division already referred to. The total through rate, whether fare or freight, is a fixed sum. Before dividing this sum, a certain amount is deducted and allowed to the Union Pacific on account of the Omaha Bridge. It is a mistake to suppose that, if this amount were not so deducted and allowed, the through rate would be diminished by an equal sum. No such reduction has usually been made in other and similar cases elsewhere, or would probably be made in this case, but the total amount remaining the same, it is not impossible it might be divided in a slightly different ratio. In other words, the Omaha Bridge allowance is a matter between the roads, in no way necessarily affecting the public; and, as a rule, the roads have been found quite capable of taking care of their own interests. In this case it is not proposed that the government should establish a fixed through rate; and it is not apparent why it should concern itself in the division made by the roads of the rate fixed by them.

The same fares and freights are, however, charged on the local travel and traffic between Omaha and Council Bluffs as upon the through, that is, 50 cents for each person and \$10 per car, or 5 cents per hundred, on merchandise. As respects the last, judged by all usage, the amount named cannot be considered unreasonable as a terminal charge in a case involving such an outlay for facilities as that at Omaha. So far as the directors know, it is customary for railroads under such circumstances to demand and receive terminals, and 5 cents per hundred is not an unusual one. The case is different as respects local passengers. For them it is neither customary nor in itself reasonable to charge heavy local terminals. They handle themselves, and share the benefits of stations, bridges, etc., only in common with all other passengers. For instance, many railroads in this country terminating in great cities have far larger amounts permanently invested in terminal facilities than the Union Pacific has invested between Omaha and Council Bluffs, including

those two places. For the carriage of merchandise to points on the line of such roads three miles from their termini, those roads charge and receive, probably, at least 5 cents a hundred. At any rate such a charge would not be considered unreasonable. Not one of those roads, or indeed any road in the country, would think of charging a local fare of 50 cents on passengers between the same points. If they did, it would simply result in their passengers taking other means of conveyance. In such cases 10 cents is the usual and reasonable fare, and the directors are unable to see any reason why this should not be adopted by the Union Pacific as the local passenger rate across the bridge.

#### THE LAND GRANT.

But one further subject remains to be considered. The interest of the Union Pacific Company in such portions of its land grant as still remain unsold has, under a recent decision of the Department of the Interior, become a subject of litigation. It is no part of the duty of the government directors to discuss the merits of that question. However this litigation may result, there are certain questions connected with the Union Pacific land grant which apparently will not be affected by it, but which from every point of view would seem to call for some additional legislation. As is now generally well known, the land covered by the Union Pacific grant varies greatly in character. Scarcely one quarter part of it can be classed as arable, while more than half the remainder—some 4,500,000 acres—is supposed to be available for grazing purposes. The rest—3,000,000 acres—comes under the general denomination of waste lands, the value of which, apart from mineral deposits, depends upon climatic changes in the more or less remote future. To be of any real service these lands not arable must be held in large tracts as cattle ranges, vast extents of which are dependent for value on the control of a water front. The system of alternate sections in which this land is now held under the existing land-grant legislation effectually puts a stop to a disposal of it. Alternate sections only can be conveyed, and the control of a water course in one section may imply a practical enjoyment without ownership of several adjoining sections. Under these circumstances the expediency of some legislation affecting the grazing and waste lands west of a point at or near North Platte would seem to be obvious. The directors are aware that this whole subject was discussed in the annual report of the Secretary of the Interior for the year ending June 30, 1877 (p. 21), and they refer to it now simply because nothing has yet been done to carry out the recommendations then made. A personal examination on the spot shows that the matter is one of consequence. The mistake of applying legislation intended for arable lands to grazing or desert lands should be rectified, and rectified in the manner already suggested in the report referred to. An exchange should be made—the government ceding to the railroad company all the sections on one side of the road, and receiving from it, in lieu thereof, all the sections on the other side of it. In this way the interests of both parties would be subserved, while title could be given to tracts of the necessary size. It is unnecessary to discuss at this time the details of the proposed legislation. The necessary provision would, of course, be made in it to protect all private rights heretofore acquired. As to its general expediency there would, however, seem little room for question.

CHARLES F. ADAMS, JR.,  
DANIEL CHADWICK,  
GEORGE B. SMYTHE,  
RALPH P. BUCKLAND,  
CHARLES C. HOUSEL.

#### The Chemical Composition and Physical Properties of Steel Rails.\*

BY C. B. DUDLEY, PH.D., CHEMIST, PENNSYLVANIA RAILROAD COMPANY.

In the spring of 1877, the Pennsylvania Railroad Company became so dissatisfied with the average life and wear of the steel rails it was then able to procure that it determined to make an investigation into the chemical composition and physical properties of steel rails, with a view, first, to answering the question why one steel rail has to be removed from the track after, perhaps, 8 months' service, while another lasts 10 years; and, secondly, if this investigation succeeded in throwing light on this important subject, to use this information in securing better rails in the future. The results of that investigation are contained in the following report. In presenting this report to the Institute of Mining Engineers, which I am permitted to do by the kindness of the officers of the Pennsylvania Railroad Company, it has been thought best to retain the form and style in which the report was written. For although the report was originally written for the officers of the Pennsylvania Railroad Company, and, consequently, the discussion of details made a little more full than if it had been written as a scientific paper, yet this very fullness of detail may not be amiss in a field where knowledge is so urgently needed.

#### REPORT.

Theo. N. Ely, Esq., Supt. Motive Power, Penna. R. R. Co.

DEAR SIR: I have finished the examination of the subject of steel rails in connection with their chemical constitution, physical properties and wear, which has occupied my attention and study, more or less constantly, for six months past, and beg leave to present thereon the following report:

The question which led to, and has followed in all its details, the investigation embraced in this report, is: How shall the Pennsylvania Railroad Company obtain steel rails which shall give a satisfactory wear and be uniform in quality?

In order to understand the attempt which has been made to answer this question, it will be necessary to state a few preliminary principles. It seems to be agreed among metallurgists, that the quality of a piece of steel depends upon two sets of circumstances: first, upon its chemical constitution, and, second, upon the treatment which the metal receives either during or after its manufacture. In other words, a piece of steel of certain chemical constitution and treatment will have certain physical qualities of strength, elasticity, ductility, power to resist wear, etc.; or again, a different chemical constitution and treatment will give a piece of steel which will differ in one or more of these respects from the first; the former being possibly more valuable for rails, the latter for cutting-tools.

Now it is to be confessed at the outset, that our knowledge of these two sets of circumstances, viz., the chemical constitution and treatment necessary to secure such a piece of steel as is desired, is far from being all that could be wished for. Nevertheless, some things are known, and the work which is described below is an attempt to add to our knowledge in this respect, with regard to steel rails.

Now, inasmuch as all our steel rails are made at present by the Bessemer or pneumatic process, and inasmuch as the conditions of successful working of this process are pretty well understood, it is assumed that the treatment which the steel receives during manufacture is constant or always alike. That this is an actual fact in prac-

tice, is probably not true. The carelessness of workmen, and the want of proper appliances, may at times cause more or less variation in the treatment which the successive "blows" or heats in the Bessemer converter receive. The variations are, however, undoubtedly small, and where care is taken, and the Bessemer process given its full chance, the want of uniformity of product, so far as that uniformity depends upon treatment or method of manufacture, should be very small. I would not be understood as saying, however, that I think the Bessemer process has reached its full development, or is incapable of further improvement. The difficulty of obtaining solid ingots, whether it is better to use the bottom or top cast, whether the slag is all separated before casting, at what temperature the rail should go through the rolls, and especially the last pass, and how to get this temperature, are questions still awaiting solution, and I think it undoubted, that to one or more, or possibly all combined, of these uncertainties are due some of the anomalies which are often met with in steel.

Nevertheless, assuming, as has already been stated, that the Bessemer process, as at present understood and worked, is capable, in careful hands, of turning out a moderately uniform product, so far as that uniformity depends upon treatment or method of manufacture—which is undoubtedly the case—the question how to obtain a good rail becomes one as to the chemical composition of the steel, and this is the part of the problem to which I have devoted some labor and study. We are fortunately, however, not entirely dependent for uniformity of product, so far as that uniformity depends upon treatment or method of manufacture, upon the uniformity with which the rail manufacturers work the Bessemer process. Just here comes in the sphere for appropriate physical tests and inspection. For example, it seems clear to me that if a "blow" or heat in the Bessemer converter is badly treated at any point during the manufacture, so that the steel is spoiled, appropriate physical tests and inspection will reveal this fact, and thus enable us to protect ourselves by rejecting that "blow." So that the question with which we started, viz.: How shall the Pennsylvania Railroad Company obtain steel rails which shall give satisfactory wear and be uniform in quality? seems to be resolved into two others, viz.: (1) With the present known metallurgical methods in the Bessemer process, what chemical composition shall the Pennsylvania Railroad Company prescribe for its rails? and (2) What physical tests and inspection shall it apply to secure uniformity of product? What follows is an attempt to answer these questions.

#### I. AS TO CHEMICAL COMPOSITION.

It is well known that there are six impurities which exist in nearly all iron and steel in greater or less amount, which are known to have important influences upon its quality, even in small quantities. These are carbon, phosphorus, silicon, manganese, sulphur and copper, and when we speak of the chemical composition of steel, we mean the amount of these various impurities which the steel contains. Steel, and especially pig-iron, contain other impurities, such as titanium, cobalt, nickel, arsenic, etc., but these are commonly disregarded in analysis because their amount is usually very small, and some of them are not known to have any influence upon the quality of the metal. A discussion as to the influence of these various impurities upon the quality of steel will follow later. It is sufficient here to say, that almost the only effect that sulphur and copper are known to have on steel, is to render it what is technically known as "red short," that is, if a steel rail has too much sulphur and copper in it, it crushes in the rolls or flies to pieces during manufacture. I am unable to find, anywhere, that sulphur and copper are said to have a deleterious effect on the wear or durability of a rail, and, indeed, some metallurgists claim that they are advantageous in this respect. I have, therefore, not determined the sulphur or copper in the analysis given below, and would not recommend to prescribe any specifications in regard to them. We can safely trust the rail manufacturers not to give us rails containing too much sulphur and copper.

As to the other four impurities, the question now arises, how much of these various substances ought a good steel rail to contain? In order to answer this question, twenty-five pieces of steel rail have been carefully analyzed for carbon, phosphorus, silicon and manganese. The borings for analysis were taken out of the physical test pieces described below. The chemical work was all done in duplicate. The carbon was determined by combustion, working upon 7 grams, dissolving out the carbon with solution of the double chloride of copper and ammonium, and burning with chromate of lead. The phosphorus was determined by the molybdate of ammonium method, working upon 8 grams, and dissolving the steel in aqua regia. The manganese was determined by the bromine method, separating the iron as basic acetate, and using acetate of soda as the precipitant. The silicon was determined in the usual way, working upon 10 grams, and dissolving in hydrochloric acid. The twenty-five samples of steel rail which were analyzed have all been in actual service; some of them have broken in service, some have crushed in service, some have worn badly with short service, and some have endured long and hard service. The brands of steel represented in the series, are: Pennsylvania steel, Cambria steel, Lackawanna Iron & Coal Co.'s steel, Cammel steel, Mersey steel, Ebbw Vale steel and John Brown steel. It was thought that the series would represent, as fairly as a series of twenty-five samples could do, the actual results of good and bad service of rails on the Pennsylvania Railroad. Moreover, the samples were taken from all parts of the road, thereby rendering inoperative the influence of local causes upon the life and wear of the rails. If now the chemical composition of the good rails should show uniformity within narrow limits, while the chemical composition of the bad rails should likewise show uniformity; and if these uniformities of chemical composition in the good rails and bad rails should differ from each other, it would seem to be fair to conclude that the composition of the bad rails should be avoided, while that of the good rails should be adopted. That the good rails show a moderate uniformity of chemical composition, different from that of the bad rails, will be evident, I think, from an inspection of the analyses which follow.

One or two things more ought to be mentioned. In order to measure the value of a rail as to whether good or bad, the approximate tonnage which has passed over each of these pieces of rail has been computed; it being of course evident to all that the burden which a rail has sustained, even though approximately determined, is a much more accurate measure of its value than time of service. Again, position in a track, whether on a curve or on a straight line, and also whether subject to high speed or not, obviously have an influence upon the durability of a rail, and attention has been given to these points in estimating the value of a rail. It will be noticed in the tables which follow that the principle of measuring the value of a rail by the tonnage which has passed over it has not been strictly followed. The rails have been divided in the tables into two classes on this principle, viz.: Those which crushed or broke in service and those which did not crush or break in service. The former are regarded as bad rails and the latter as good rails. This principle of division brings among the bad rails four whose tonnage is higher than the lowest tonnage of any rail among the good ones. But in view of the liability to accident which a broken or crushed rail may occasion, I think no one

\* A paper read before the October (1878) meeting of the American Institute of Mining Engineers.



will claim that a rail which has broken or crushed in service should be classed among good rails, even though its tonnage may entitle it to be so rated.

Finally, as a means of determining whether good rails differed from bad rails in physical qualities, such as tensile strength, ductility, etc., and if it was found that they did so differ, as a means of enabling us to specify what physical tests the steel for our rails ought to stand, careful physical tests have been made of every piece of steel analyzed except two, the samples sent for analysis of these two being so small as to prevent physical tests being made. The physical tests were made on Prof. Thurston's torsional testing machine, as being the best means of determining the largest number of physical qualities at a single test. A copy of the diagrams obtained in making these tests accompanies this report, and will be referred to later.

The history of each piece of rail analyzed, together with an outline sketch of the piece (one-third size) as it appeared when removed from the track, the tonnage, chemical analysis, and results of physical tests are given in order below. Following these is a tabulated statement of these results, and the conclusion drawn from them.

## CHEMICAL ANALYSIS.

Carbon.....	0.359
Phosphorus.....	.156
Manganese.....	.505
Silicon.....	.035

Total hardeners..... 1.055  
" in P. units..... 39.4

## PHYSICAL TESTS.

Angle of torsion.....	111°
Moment of torsion.....	333
Tensile strength at rupture.....	78,255
Tensile strength at elastic limit.....	30,550
Percentage of elongation.....	16.898
Proportional ultimate resilience.....	29.80

No. 32.—Broken near Edgar Thomson Steel Works, first time train passed over it. Tonnage, 0,000,000 tons.

## CHEMICAL ANALYSIS.

Carbon.....	0.323
Phosphorus.....	.135
Manganese.....	.522
Silicon.....	.035

Total hardeners..... 1.015  
" in P. units..... 36.4

## PHYSICAL TESTS.

Angle of torsion.....	100°
Moment of torsion.....	340
Tensile strength at rupture.....	70,900
Tensile strength at elastic limit.....	33,135
Percentage of elongation.....	15.509
Proportional ultimate resilience.....	28.60

No. 83.—In service from June, 1875, to September, 1876; sixteen months. Was in south track on 9° curve, just east of Columbia Tunnel. Broke in service. Tonnage, 10,027,131 tons.

## CHEMICAL ANALYSIS.

Carbon.....	0.337
Phosphorus.....	.056
Manganese.....	.574
Silicon.....	.056

Total hardeners..... .823  
" in P. units..... 27.1

## PHYSICAL TESTS.

No physical tests were made, because of smallness of piece of rail sent.

No. 292.—In service from October, 1868, to November, 1870; eight years, one month. Was in south track on 9° curve, just west of Valley Creek Bridge. Tonnage, 44,636,201 tons.

## CHEMICAL ANALYSIS.

Carbon.....	0.573
Phosphorus.....	.075
Manganese.....	.853
Silicon.....	.182

Total hardeners..... 1.688  
" in P. units..... 52.9

## PHYSICAL TESTS.

Angle of torsion.....	101°
Moment of torsion.....	433
Tensile strength at rupture.....	101,755
Tensile strength at elastic limit.....	43,005
Percentage of elongation.....	14.169
Proportional ultimate resilience.....	36.81

No. 227.—In service from September, 1872, to December, 1876; four years, three months. Was in south track on tangent, about midway between South Elizabeth and Linden. Broke in service. Tonnage, 16,000,728 tons.

## CHEMICAL ANALYSIS.

Carbon.....	0.354
Phosphorus.....	.132
Manganese.....	.552
Silicon.....	.050

Total hardeners..... 1.088  
" in P. units..... 38.5

## PHYSICAL TESTS.

No physical tests were made, because of smallness of piece of rail sent.

No. 282.—In service from August, 1875, to January, 1877; one year, five months. Was in single track near Marr's Run Station, on N. C. Ry. Broke in service. On tangent. Tonnage, 4,535,318 tons.

## CHEMICAL ANALYSIS.

Carbon.....	0.287
Phosphorus.....	.056
Manganese.....	.670
Silicon.....	.035

Total hardeners..... 1.148  
" in P. units..... 36.6

## PHYSICAL TESTS.

Angle of torsion.....	67°
Moment of torsion.....	306
Tensile strength at rupture.....	71,910
Tensile strength at elastic limit.....	30,550
Percentage of elongation.....	6.467
Proportional ultimate resilience.....	16.65

No. 347.—Broke after five days' service on New York Division. Tonnage, 0,000,000 tons.



No. 371.—In service from July, 1876, to March, 1877; eight months. Was in single track, on Tyrone & Clearfield Division, south of Mount Pleasant. On curve 16°. Tonnage, 2,741,056 tons.

## CHEMICAL ANALYSIS.

Carbon.....	0.386
Phosphorus.....	.127
Manganese.....	.380
Silicon.....	.053

Total hardeners..... .946  
" in P. units..... 35.8

## PHYSICAL TESTS.

Angle of torsion.....	85°
Moment of torsion.....	342
Tensile strength at rupture.....	80,370
Tensile strength at elastic limit.....	47,000
Percentage of elongation.....	10.223
Proportional ultimate resilience.....	24.68



No. 372.—In service from July, 1876, to March, 1877; eight months. Was in single track on 18° curve, Tyrone & Clearfield Division, south of Mount Pleasant. Tonnage, 2,741,056 tons.

## CHEMICAL ANALYSIS.

Carbon.....	0.416
Phosphorus.....	.155
Manganese.....	.460
Silicon.....	.034

Total hardeners..... 1.065  
" in P. units..... 40.3

## PHYSICAL TESTS.

Angle of torsion.....	102°
Moment of torsion.....	346
Tensile strength at rupture.....	81,310
Tensile strength at elastic limit.....	30,550
Percentage of elongation.....	14.433
Proportional ultimate resilience.....	29.26



No. 373.—In service from July, 1876, to March, 1877; eight months. Was in single track on 20° curve, Tyrone & Clearfield Division, south of Mount Pleasant. Tonnage, 2,741,056 tons.

## CHEMICAL ANALYSIS.

Carbon.....	0.300
Phosphorus.....	.138
Manganese.....	.412
Silicon.....	.024

Total hardeners..... .874  
" in P. units..... 33.2

## PHYSICAL TESTS.

Angle of torsion.....	102°
Moment of torsion.....	281
Tensile strength at rupture.....	68,035
Tensile strength at elastic limit.....	25,850
Percentage of elongation.....	14.433
Proportional ultimate resilience.....	23.06



No. 388.—In service from March, 1867, to March, 1877; ten years. Was in north track on a tangent near Ardmore Station. Tonnage, 37,005,142 tons.

## CHEMICAL ANALYSIS.

Carbon.....	0.303
Phosphorus.....	.106
Manganese.....	.316
Silicon.....	.032

Total hardeners..... .817  
" in P. units..... 34.6

## PHYSICAL TESTS.

Angle of torsion.....	120°
Moment of torsion.....	322
Tensile strength at rupture.....	75,070
Tensile strength at elastic limit.....	31,725
Percentage of elongation.....	19.514
Proportional ultimate resilience.....	31.21



No. 389.—In service from March, 1872, to April, 1877; five years, one month. Was on south track on a curve, one mile west of Huntingdon. Tonnage, 34,333,639 tons.

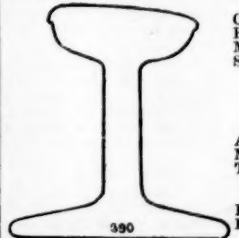
## CHEMICAL ANALYSIS.

Carbon.....	0.343
Phosphorus.....	.127
Manganese.....	.670
Silicon.....	.036

Total hardeners..... 1.176  
" in P. units..... 39.3

## PHYSICAL TESTS.

Angle of torsion.....	121°
Moment of torsion.....	320
Tensile strength at rupture.....	75,200
Tensile strength at elastic limit.....	30,550
Percentage of elongation.....	19.813
Proportional ultimate resilience.....	31.02



No. 390.—In service from March, 1868, to March, 1877; nine years. Was in south track on 2° curve, on eastern slope of mountain. Pittsburgh Division. Tonnage, 47,332,411 tons.

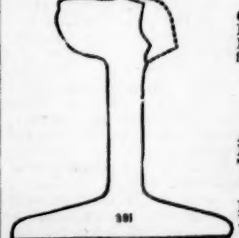
## CHEMICAL ANALYSIS.

Carbon.....	0.294
Phosphorus.....	.181
Manganese.....	.454
Silicon.....	.020

Total hardeners..... .849  
" in P. units..... 36.0

## PHYSICAL TESTS.

Angle of torsion.....	117°
Moment of torsion.....	333
Tensile strength at rupture.....	78,255
Tensile strength at elastic limit.....	33,005
Percentage of elongation.....	18.626
Proportional ultimate resilience.....	32.42



No. 391.—In service from June, 1871, to April, 1877; five years, ten months. Was in south track on 4½° curve, 1,700 feet west of M. P., 84 from Pittsburgh. Tonnage, 30,873,173 tons.



No. 392.—In service from April, 1871, to April, 1877; six years. Was in south track on 4° curve, 800 feet east of M. P., 106 from Pittsburgh. Tonnage, 32,957,247 tons.

## CHEMICAL ANALYSIS.

Carbon.....	0.231
Phosphorus.....	.067
Manganese.....	.364
Silicon.....	.047

Total hardeners..... .729  
" in P. units..... 26.0

## PHYSICAL TESTS.

Angle of torsion.....	151°
Moment of torsion.....	294
Tensile strength at rupture.....	69,000
Tensile strength at elastic limit.....	30,550
Percentage of elongation.....	29.548
Proportional ultimate resilience.....	37.24



No. 393.—In service from July, 1867, to July, 1873, in north track at M. P., 115 from Philadelphia; then from July, 1873, to April, 1877, in No. 1, south siding, Mifflin Yard. Total service, nine years, ten months. Tonnage, 17,083,416 tons.

## CHEMICAL ANALYSIS.

Carbon.....	0.219
Phosphorus.....	.065
Manganese.....	.272
Silicon.....	.028

Total hardeners..... .584  
" in P. units..... 20.6

## PHYSICAL TESTS.

Angle of torsion.....	217°
Moment of torsion.....	285
Tensile strength at rupture.....	66,975
Tensile strength at elastic limit.....	28,200
Percentage of elongation.....	54.944
Proportional ultimate resilience.....	49.63



No. 394.—In service from April, 1871, to April, 1877; six years. Was in south track on 2° curve, 2,600 feet west of M. P., 27 from Pittsburgh. Tonnage, 25,043,350 tons.

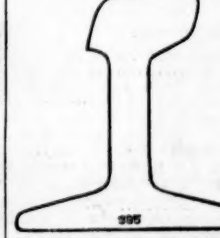
## CHEMICAL ANALYSIS.

Carbon.....	0.286
Phosphorus.....	.083
Manganese.....	.418
Silicon.....	.023

Total hardeners..... .810  
" in P. units..... 27.3

## PHYSICAL TESTS.

Angle of torsion.....	149°
Moment of torsion.....	322
Tensile strength at rupture.....	75,070
Tensile strength at elastic limit.....	45,825
Percentage of elongation.....	28.857
Proportional ultimate resilience.....	41.05



No. 395.—In service from September, 1872, to March, 1877; four years, seven months. Was in south track on 4° curve, 1,200 feet west of M. P., 59 from Pittsburgh. Tonnage, 24,606,889 tons.

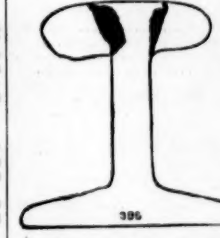
## CHEMICAL ANALYSIS.

Carbon.....	0.353
Phosphorus.....	.103
Manganese.....	.576
Silicon.....	.050

Total hardeners..... 1.091  
" in P. units..... 36.5

## PHYSICAL TESTS.

Angle of torsion.....	134°
Moment of torsion.....	338
Tensile strength at rupture.....	79,430
Tensile strength at elastic limit.....	32,000
Percentage of elongation.....	23.800
Proportional ultimate resilience.....	37.40



No. 396.—In service from January, 1874, to January, 1877; three years. Was in Subdivision 11, Pittsburgh Division; the records of which were destroyed by the riots. Tonnage, 13,683,266 tons.

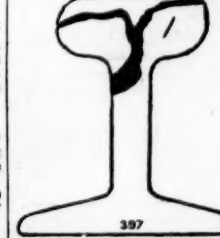
## CHEMICAL ANALYSIS.

Carbon.....	0.350
Phosphorus.....	.134
Manganese.....	.626
Silicon.....	.058

Total hardeners..... 1.168  
" in P. units..... 40.5

## PHYSICAL TESTS.

Angle of torsion.....	105°
Moment of torsion.....	342
Tensile strength at rupture.....	80,370
Tensile strength at elastic limit.....	36,425
Percentage of elongation.....	15.237
Proportional ultimate resilience.....	29.06



No. 397.—In service from July, 1872, to May, 1877; four years, seven months. Was in south track on tangent 650 feet west of M. P., 11 from Pittsburgh. Tonnage, 21,935,613 tons.

## CHEMICAL ANALYSIS.

Carbon.....	0.365
Phosphorus.....	.130
Manganese.....	.458
Silicon.....	.020

Total hardeners..... .973  
" in P. units..... 35.3

## PHYSICAL TESTS.

Angle of torsion.....	82°
Moment of torsion.....	260
Tensile strength at rupture.....	61,100
Tensile strength at elastic limit.....	25,850
Percentage of elongation.....	9.545
Proportional ultimate resilience.....	16.86



No. 398.—In service from January, 1871, to March, 1877; six years, two months. Was in north track on 4° curve, 120 feet west of M. P., 12 from Pittsburgh. Tonnage, 27,206,043 tons.

## CHEMICAL ANALYSIS.

Carbon.....	0.225
Phosphorus.....	.111
Manganese.....	.318
Silicon.....	.016

Total hardeners..... .670  
" in P. units..... 25.8

## PHYSICAL TESTS.

Angle of torsion.....	130°
Moment of torsion.....	282
Tensile strength at rupture.....	66,270
Tensile strength at elastic limit.....	27,025
Percentage of elongation.....	22.586
Proportional ultimate resilience.....	28.93





No. 413.—In service from June, 1867, to October, 1876; nine years, four months. Was in single track on 8° 40' curve, at west end of Schuylkill Bridge, Del. Ex. R. R. Tonnage, 36,901,508 tons.

CHEMICAL ANALYSIS.	
Carbon.....	0.233
Phosphorus.....	.041
Manganese.....	.208
Silicon.....	.074

Total hardeners.....556  
in P. units.....19.7

PHYSICAL TESTS.	
Angle of torsion.....	175°
Moment of torsion.....	280
Tensile strength at rupture.....	65,800
Limit.....	28,435
Percentage of elongation.....	38.239
Proportional ultimate resistance.....	30.40



No. 414.—In service from May, 1867, to November, 1876; nine years, six months. Was in west bound freight track on tangent, east of Thirty-fifth Street Bridge, West Philadelphia. Tonnage, 34,839,538 tons.

CHEMICAL ANALYSIS.	
Carbon.....	0.309
Phosphorus.....	.058
Manganese.....	.326
Silicon.....	.030

Total hardeners.....723  
in P. units.....24.1

PHYSICAL TESTS.	
Angle of torsion.....	148°
Moment of torsion.....	202
Tensile strength at rupture.....	68,020
Limit.....	27,730
Percentage of elongation.....	28.514
Proportional ultimate resistance.....	35.86



No. 415.—In service from April, 1867, to July, 1876; nine years, three months. Was in south track, four years on 2° curve, and five years on tangent, near Marysville, Middle Division. Tonnage, 48,037,879 tons.

CHEMICAL ANALYSIS.	
Carbon.....	0.336
Phosphorus.....	.079
Manganese.....	.458
Silicon.....	.061

Total hardeners.....934  
in P. units.....31.3

PHYSICAL TESTS.	
Angle of torsion.....	137°
Moment of torsion.....	321
Tensile strength at rupture.....	75,435
Limit.....	31,725
Percentage of elongation.....	24.833
Proportional ultimate resistance.....	36.75



No. 416.—In service from June, 1868, to September, 1876; eight years, three months. Was in south track on tangent opposite Harrisburg Freight Warehouse. Tonnage, 40,354,754 tons.

CHEMICAL ANALYSIS.	
Carbon.....	0.283
Phosphorus.....	.114
Manganese.....	.354
Silicon.....	.030

Total hardeners.....761  
in P. units.....29.0

PHYSICAL TESTS.	
Angle of torsion.....	127°
Moment of torsion.....	280
Tensile strength at rupture.....	67,915
Limit.....	28,200
Percentage of elongation.....	31.647
Proportional ultimate resistance.....	29.87



No. 417.—In service from December, 1867, to July, 1876; nine years, six months. Was in north track on 4½° curve, at Jacksonville Water station, Middle Division. Tonnage, 34,108,667 tons.

CHEMICAL ANALYSIS.	
Carbon.....	0.345
Phosphorus.....	.075
Manganese.....	.420
Silicon.....	.041

Total hardeners.....887  
in P. units.....29.6

PHYSICAL TESTS.	
Angle of torsion.....	124°
Moment of torsion.....	312
Tensile strength at rupture.....	73,320
Limit.....	30,080
Percentage of elongation.....	20.722
Proportional ultimate resistance.....	31.77

TABLE I.  
Showing Tonnage, Location and Results of Chemical Analysis of Twenty-five Samples of Steel Rails.

Rail No.	Tonnage.	Location.	C.	Phos.	Man.	Si.	Total
415	48,037,879	2° C. & tangent.	0.336	0.079	0.458	0.061	0.834
416	47,354,754	Tangent.	0.283	0.114	0.334	0.030	0.761
390	47,332,411	2° Curve.	0.291	0.057	0.354	0.068	0.770
202	44,636,201	9° "	0.337	0.050	0.374	0.050	0.823
413	30,901,508	8½° "	0.233	0.041	0.208	0.074	0.556
414	34,839,538	Tangent.	0.309	0.058	0.326	0.030	0.723
417	34,108,667	4½° Curve.	0.345	0.075	0.420	0.041	0.887
392	32,057,247	4° "	0.231	0.087	0.304	0.047	0.729
398	27,290,043	4° "	0.225	0.111	0.318	0.016	0.670
394	25,043,350	2° "	0.286	0.083	0.418	0.023	0.810
395	24,606,889	4° "	0.353	0.103	0.576	0.059	1.091
393	17,083,416	Tangent.	0.219	0.065	0.272	0.028	0.584
388	37,003,142	Curve.	0.309	0.166	0.316	0.032	0.817
380	34,333,630	4½° Curve.	0.343	0.127	0.460	0.034	1.068
391	30,873,173	4½° "	0.294	0.181	0.354	0.020	0.849
307	21,835,013	Tangent.	0.305	0.130	0.458	0.020	0.973
277	16,600,728	Unknown.	0.573	0.075	0.853	0.182	1.688
306	13,683,296	9° Curve.	0.350	0.134	0.626	0.058	1.168
83	10,027,131	9° "	0.323	0.135	0.522	0.035	1.015
282	4,535,318	Tangent.	0.354	0.132	0.552	0.050	1.088
371	2,741,056	16° Curve.	0.386	0.127	0.580	0.032	1.176
372	2,741,056	17° "	0.416	0.125	0.460	0.034	1.068
373	2,741,056	20° "	0.300	0.138	0.412	0.024	0.874
347	5 days' service.	Unknown.	0.387	0.056	0.670	0.035	1.148
32	Broke 1st train.	"	0.350	0.156	0.505	0.035	1.055

TABLE II.  
Showing Tonnage, Location and Results of Physical Tests of Twenty-five Samples of Steel Rail.

Rail No.	Tonnage.	Location.	Angle of torsion.	Moment of torsion.	Tensile strength.	Elastic limit.	Ultimate resistance.
415	48,037,879	2° C. and tangent.	137°	321	75,435	31,725	24.833
416	47,354,754	Tangent.	127°	280	67,915	28,200	29.87
390	47,332,411	2° Curve.	129°	302	70,970	32,900	23.13
202	44,636,201	9° "	175°	280	65,800	28,435	30.40
413	30,901,508	8½° "	148°	292	68,020	27,730	28.514
414	34,839,538	Tangent.	124°	312	73,320	30,080	20.722
417	34,108,667	4½° Curve.	151°	294	69,060	30,550	23.95
392	32,057,247	4° "	120°	282	66,270	27,025	28.03
398	27,290,043	4° "	149°	322	75,670	45,825	28.88
394	25,043,350	2° "	134°	338	70,430	32,900	23.97
395	24,606,889	4° "	217°	285	66,975	28,200	29.87
393	17,083,416	Tangent.	120°	322	75,670	31,725	24.83
388	37,003,142	Curve.	121°	320	75,200	30,550	23.95
380	34,333,630	4½° Curve.	136°	333	78,255	33,605	26.42
391	30,873,173	4½° "	182°	260	61,100	25,850	16.86
307	21,835,013	Tangent.	101°	433	101,755	43,005	32.81
277	16,600,728	Unknown.	105°	342	80,370	36,425	29.06
306	13,683,296	9° Curve.	106°	340	79,900	33,135	28.60
83	10,027,131	9° "	85°	342	80,370	47,000	24.68
282	4,535,318	Tangent.	102°	346	81,310	30,550	24.26
371	2,741,056	16° Curve.	102°	281	66,035	25,850	23.06
372	2,741,056	17° "	67°	306	71,010	30,550	24.05
373	2,741,056	20° "	111°	333	78,255	30,550	29.80
347	5 days' service.	Unknown.					
32	Broke 1st train.	"					

\* No tests made of this rail.

TABLE III.  
Showing Tonnage, Location, Results of Chemical Analysis and Physical Tests of Twenty-five Samples of Steel Rail.

Rail No.	Tonnage—Million tons.	Location.	Carbon.	Phosphorus.	Manganese.	Silicon.	Total in phos. units.	Tensile strength—1,000 lbs.	Elastic limit—1,000 lbs.	Percentage of elongation.	Ultimate resistance.	Did not break or crush in service.
415	48	2° C. and tangent.	0.336	0.079	0.458	0.061	0.834	75	32	25	37	
416	47	Tangent.	0.283	0.114	0.334	0.030	0.761	68	28	30	30	
390	47	2° Curve.	0.291	0.057	0.354	0.068	0.770	71	33	21	32	
202	45	9° "	0.337	0.050	0.374	0.050	0.823	No test made				
413	31	8½° "	0.233	0.041	0.208	0.074	0.556	66	28	38	30	
414	35	Tangent.	0.309	0.058	0.326	0.030	0.723	69	28	28	36	
417	34	4½° Curve.	0.345	0.075	0.426	0.041	0.887	73	30	21	32	
392	32	4° "	0.231	0.087	0.304	0.047	0.729	69	30	29	37	
398	27	4° "	0.225	0.111	0.318	0.016	0.670	66	27	23	29	
394	25	2° "	0.286	0.083	0.418	0.023	0.810	75	46	20	42	
395	25	4° "	0.353	0.103	0.576	0.059	1.091	79	33	24	37	
393	17	Tangent.	0.219	0.065	0.272	0.028	0.584	67	28	55	50	
388	37	Tangent.	0.303	0.166	0.316	0.032	0.817	76	32	19	31	
380	34	Curve.	0.343	0.127	0.460	0.034	1.068	75	30	20	31	
391	31	4½° Curve.	0.294	0.181	0.354	0.020	0.849	78	34	19	32	
307	22	Tangent.	0.305	0.130	0.458	0.020	0.973	61	26	9	17	
277	17	Unknown.	0.573	0.075	0.853	0.182	1.688	101	43	14	37	
306	14	9° Curve.	0.350	0.134	0.626	0.058	1.168	80	33	15	29	
83	10	9° "	0.323	0.135	0.522	0.035	1.015	80	33	15	29	
282	5	Tangent.	0.354	0.132	0.552	0.050	1.088	No test made				
371	3	16° Curve.	0.386	0.127	0.580	0.032	1.176	80	47	10	25	
372	3	17° "	0.416	0.125	0.460	0.034	1.068	81	30	14	29	
373	3	20° "	0.300	0.138	0.412	0.024	0.874	66	26	14	23	
347	0	Unknown.	0.387	0.056	0.670	0.035	1.148	72	30	6	17	
32	0	"	0.350	0.156	0.505	0.035	1.055	78	30	17	30	

Table III. contains a condensed statement of the results of chemical analysis and physical tests, together with the tonnage and location of the 25 samples of rails analyzed. As has been previously mentioned, the rails analyzed have been divided into two groups. Those which did not break or crush in service have been placed first in Table III., and in the other tables of this report, and embrace the first 12 samples, down to and including No. 393. The remaining 13 rails either crushed or broke in service. To a study of this statement attention is now directed.

But first a brief discussion as to the influence of the various substances affecting the quality of steel, viz., carbon, phosphorus, silicon and manganese, upon the metal, will perhaps be in order. And here, at the start, I should like to frankly confess that our knowledge of the influence of these substances upon each other, and upon steel, is far from being as complete as we could wish. How thoroughly this lack of knowledge is recognized, may be inferred from the fact that one of the important duties with which the United States Test Commission, organized some two years ago, was charged, was this very point of the influence of the various impurities which exist in iron and steel upon the metal and upon each other in the metal. In view of this lack of knowledge, we can only, as it seems to me, apply what is already known, and, at the same time, study the results which we ourselves have obtained, with a view of deriving from them, as far as possible, the information they are calculated to teach. What, then, is the influence, so far as we know, of phosphorus, silicon, carbon and manganese upon steel for rails? Phosphorus, even in very small quantities, hardens steel and makes it brittle, and, at the same time, seems to render it especially liable to fracture from percussion or blows. Silicon hardens steel and renders it brittle, but in less degree than phosphorus. Carbon hardens steel and makes it brittle, and, at the same time, up to certain limits, adds to its strength, but seems to diminish its ductility or percentage of elongation, almost directly in proportion to the increase in carbon and strength. Manganese hardens steel and renders it brittle, and adds to its strength much like carbon, but in less degree, while, at the same time, it does not seem as rapidly as carbon to diminish the ductility, or percentage of elongation, proportional to the increase of manganese and strength.

Now, it will be noticed that it is said of each of these four substances—phosphorus, silicon, carbon and manganese—that they harden steel and render it brittle. Phosphorus and silicon seem to harden steel without adding any other desirable qualities, except, perhaps, wear; while carbon and manganese seem likewise to have important influences upon the strength and ductility of the metal.

Leaving this point now for a moment, let us examine what qualities a steel rail needs to possess. A steel rail, as it seems to me, like every other piece of metal which is subject on the one hand to strain, and on the other to abrasion or wear, has two things to avoid. On the one hand, it must not be so hard and brittle as to break under the strain or blows to which it is to be subjected; while on the other, it must not be so soft as to yield too rapidly to the abrasive action which it is to be called upon to withstand. If, now, this reasoning be correct, and if the influence which we have ascribed to the carbon, phosphorus, manganese, etc., be such as they actually possess, it would seem that we ought to find, by a study of the results of the chemical analyses—since the series analyzed embraces rails which have been broken or crushed in service, as well as those which have endured long and hard service—I say it would seem that we ought to find what amount of these hardeners or brittle-makers is so great that the rails have a tendency to break or crush in service; and, this point being known, it is obvious that to get the most satisfactory wear, it is only necessary to have the rails as hard as they can be made with safety. In other words, if the limit of hardeners or brittle-makers is known, it is obviously good policy to make our rails approach this limit as closely as possible.\*

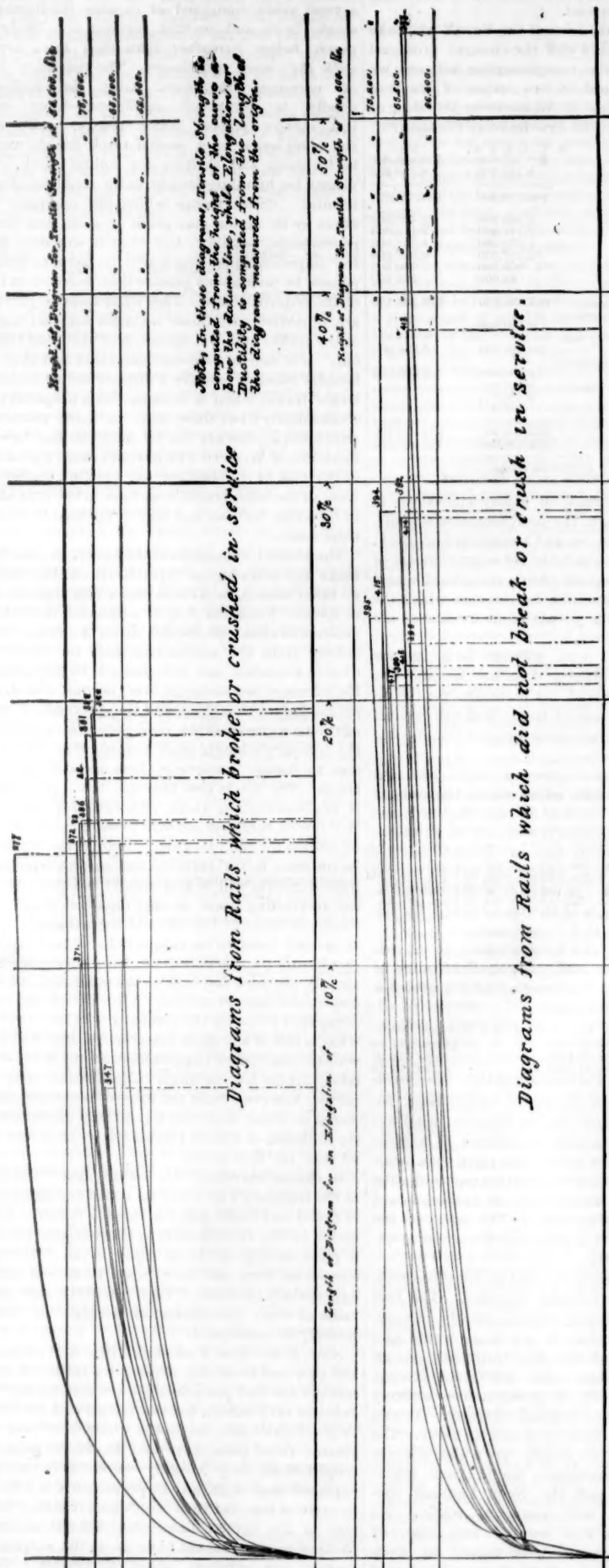
A word now as to method of studying the hardeners. If we take any single hardener and follow it through the series, regarding it alone as to its influence on the steel, we will usually find that the principal thing that we will learn will be, that if any one of these hardeners is very high the rail broke in actual service. We will also learn that in the 12 rails which did not break or crush in service, the average of the carbon is 0.287 per cent., while in those which did break or crush in service it is 0.366 per cent.; while in the 11 rails which withstood the highest tonnage, the average carbon is 0.30 per cent. Also, that in the 12 rails which did not break or crush in service, the average of the phosphorus is 0.077 per cent.; while in those rails which did break or crush in service, the average of the phosphorus is 0.132 per cent. And just here I may be permitted to call attention to what seems to me a very significant fact, viz., that in every case in which the phosphorus is above 0.12 per cent. the rail either broke or crushed in service. We will also learn by inspecting the analyses as to single elements, that the average manganese in the rails which did not break or crush is 0.369 per cent.; while the average in those which did break or crush is 0.521 per cent., and that the average silicon in the unbroken rails is 0.044 per cent., while in the broken or crushed rails it is 0.047 per cent.

But it seems to me that the true way to study the influence of the carbon, phosphorus, etc., upon steel is not to regard each one separately, but since all, are known to render steel hard and brittle, to consider them all as hardeners or brittle-makers, and study them in connection with each other. There are two ways in which this may be done.

1. We may simply add together the percentages of carbon, phosphorus, silicon and manganese, as they are given in the analysis, the sum obtained being regarded, of course, as a comparative measure of the hardness of the steel. Doing this, and we find that the average sum of these constituents in those rails which did not break or crush in service, amounts to 0.778 per cent.; while in those rails which did break or crush it is 1.030 per cent. It would, therefore, almost seem fair to conclude that we cannot with safety have the total sum of the carbon, phosphorus, silicon and manganese in our rails as high as one per cent.

2. There is another way of looking at these results of analysis which seems to lead to even better results than are obtained by simply adding together the percentages of the hardeners. It is a question which has been somewhat discussed among metallurgists, how much carbon, for example, would have the same influence in rendering a steel hard and brittle as 0.01 per cent. of phosphorus. Or again, how much silicon or manganese would have the same influence in this respect as 0.01 per cent. of phosphorus. I am not aware that any definite relations have ever been discovered between these substances in this respect. But it is,





limits for these two elements. If, now, we place the carbon at from 0.25 per cent. to 0.35 per cent., and the manganese at from 0.30 per cent. to 0.40 per cent., and are able to obtain rails on this formula, which are not injured or spoiled during the manufacture, I think we will get rails which will be entirely safe, and, at the same time, give satisfactory wear. The sum of the hardeners, measured in phosphorus units, for the limits of the formulæ, amounts to 26 for the lower limits of carbon and manganese, and to 32 for the higher. In view of the tendency to higher carbon which has seemed to prevail for a few years past in rail manufacture, it may appear that the carbon limits given above are low. But that this is correct will, I think, be evident from the considerations which follow. Of course if we could make a formula just as we

would like, it would, perhaps, be entirely scientific to take the average of the carbon, phosphorus, manganese, etc., in the best rails as the standard for this formula. Doing this for the rails which did not crush or break in service and we have, carbon, 0.287 per cent.; phosphorus, 0.077 per cent.; manganese, 0.369 per cent.; silicon, 0.044 per cent.; and the same for the 11 rails which withstood the highest tonnage, and we have, carbon, 0.30 per cent.; phosphorus, 0.091 per cent.; manganese, 0.38 per cent.; silicon, 0.045 per cent. But in view of the difficulty of obtaining low phosphorus in this country, we have put it as high perhaps as it should be, viz. 0.10 per cent. If, now, we make high carbon, we must diminish the manganese, or our total hardeners will be too high. That carbon should not be increased at the expense of manganese will, I think, be evident from an exami-

nation of the formula given just above, derived from the average composition of the best rails, as well as the separate analyses in Table III. Both the formulae given above show the carbon to be lower than the manganese, and both are within the limits which we have given for carbon and manganese, viz.: 0.25 per cent. to 0.85 per cent. for carbon and 0.30 per cent. to 0.40 per cent. for manganese. Again, in the separate analyses of the rails which did not crush or break in service, in only one case, No. 418, is the carbon higher than the manganese. Moreover, if the influence which we have ascribed to manganese, viz., that it increases strength and hardness of steel without diminishing elongation as much as carbon would do, be correct, the rails which we get on a formula in which manganese is higher than carbon, will be less liable to break or crush in service, and at the same time will, perhaps, give as satisfactory wear as if the carbon had been increased and the manganese diminished.

## II.—PHYSICAL TESTS AND INSPECTION.

The question now arises what physical tests and inspection shall the Pennsylvania Railroad Company prescribe to the rail manufacturers to enable it to secure rails uniform in quality?

The inspection which is at present employed seems to be amply sufficient to enable us to discard rails whose defects are evident to the eye. The question as to physical tests is not so easily answered. Nevertheless, three methods of applying physical tests suggest themselves.

It seems to me fatal to this test as at present conducted that the test bar,  $\frac{3}{4}$  inch square by 12 inches long, is hammered out from a piece of the rail. It is conceded, I think, that in proper hands a piece of steel is changed by hammering. We are, therefore, not testing the steel in the rails, but a different quality of steel. If the hammering test is to be continued, I would suggest that the test bar be cut from the rail head, instead of hammered from it.

2. The drop test. This test was in use for some time on the road to determine the quality and uniformity of the rails purchased. With regard to this test it may be said that unless the foundations are very solid, much of the force of the blow is lost; so that a rail tested under a rickety drop might stand the prescribed test, which, under a firm one, would yield. It would seem, therefore, that the drop test, without extreme care and inspection on the part of the railroad company to hold the rail manufacturers up to specifications, would give erroneous results. It is due to this reason, as I understand, that the drop test was abandoned.

3. Still another method of testing our rails suggests itself and leads us to the rail manufacturing process to provide these series with and use the same kind of machine upon which the physical tests of the series of rails analyzed have been made, viz.: Thurston's torsional testing machine. That this would be the most valuable method of securing uniformity in the rails furnished us will be evident, it seems to me, from a study of the physical tests in Table III. It should be stated here that of all the data in regard to the physical qualities of metal furnished by this machine, which data are given in full for record, in connection with the analyses, in the preceding pages, and are tabulated in Table II, we have selected out two, viz., tensile strength and percentage of elongation, as best expressing the value of the steel with our present knowledge of the subject. It should also be stated that the tensile strength given in this report is  $\frac{3}{4}$  of that obtained by the formula for determining the tensile strength which accompanies the machine, this being found by comparative tensile and torsion tests to most nearly express the tensile strength of this grade of steel.

Turning now our attention to Table III, to the rails which crushed or broke in service, and noting that in the case of No. 363, the test is not very reliable on account of inability to secure full-size test piece from the rail sent for analysis, and we find that every rail except two, Nos. 373 and 347, the tensile strength of these rails is 75,000 pounds or above per square inch, while the percentage of elongation is 20 per cent. or below. Turning now to the rails which did not break or crush in service, and we find, with the single exception of No. 895, the tensile strength is between 65,000 pounds and 75,000 pounds per square inch, while the percentage of elongation is 21 per cent. or above. If, therefore, we had had specifications that our rails should have a tensile strength above 65,000 pounds per square inch, and a percentage of elongation above 20 per cent., as determined by the machine referred to, a simple inspection of Table III. shows absolutely that we would have been able to reject every rail in this series which has crushed or broken in service. The same facts, and especially the defective elongation of the rails which broke or crushed in service is made evident to the eye by an inspection of the accompanying diagrams of tests of the rails analyzed and described in this report, and from which the physical tests given in this report were computed.

In view of the discussion and considerations given above, it seems fair to conclude :

1. That with our present metallurgical methods high phosphorus in rails is inconsistent with safety.
2. That silicon should be as low as is consistent with the successful working of the Bessemer process.
3. That the best range for carbon is from 0.25 per cent. to 0.35 per cent.
4. That the best range for manganese, all things considered, is from 0.30 per cent. to 0.40 per cent.
5. That the total sum of the hardeners, expressed in phosphorus units in the manner described, should not be above 31 or 32, nor below 25.
6. That the tensile strength of rails for use on the Pennsylvania Railroad, determined in the manner described in this report, should be above 65,000 pounds per square inch, and that the percentage of elongation determined in the same manner should be above 30 per cent.

I would, therefore, respectfully recommend that the following formula be prescribed for the chemical composition of rails for the use of the Pennsylvania Railroad, viz.

Phosphorus, not above.....	0.10 per cent.
Silicon.....	0.04 "
Carbon, between 0.25 and 0.45 per cent., with an aim at.....	0.30 "
Manganese, between 0.30 and 0.40 per cent., with an aim at.....	0.35 "
Sulphur and copper.....	No Specifications,
All other impurities, not more than traces.	

Also, that the rail manufacturers be requested to procure one of Prof. R. H. Thurston's torsional testing machines, and to furnish test pieces from each "blow" ready for testing, to the inspector, or other person authorized to attend to that work, who shall test the same on this machine, and that we shall be at liberty to reject all "blows" which do not conform to the physical tests shown to be essential in the body of this report.

And I would also recommend that the rail manufacturers be informed that we feel ourselves at liberty at any time to make chemical analyses of the rails furnished us, and if at any time the rails are found to differ from the above specifications, it will be regarded as a breach of contract and a proper subject for adjudication.

Very truly yours,  
CHAS. B. DUDLEY, *Chemist Penn. R. R. Co.*  
ALTOONA. Nov. 13, 1877.





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## EDITORIAL ANNOUNCEMENTS.

**Passes.**—All persons connected with this paper are forbidden to ask for passes under any circumstances, and we will be thankful to have any act of the kind reported to this office.

**Advertisements.**—We wish it distinctly understood that we will entertain no proposition to publish anything in this journal for pay, EXCEPT IN THE ADVERTISING COLUMNS. We give in our editorial columns OUR OWN opinions, and those only, and in our news columns present only such matter as we consider interesting and important to our readers. Those who wish to recommend their inventions, machinery, supplies, financial schemes, etc., to our readers can do so fully in our advertising columns, but it is useless to ask us to recommend them editorially, either for money or in consideration of advertising patronage.

**Contributions.**—Subscribers and others will materially assist us in making our news accurate and complete if they will send us early information of events which take place under their observation, such as changes in railroad officers, organizations and changes of companies, the letting, progress and completion of contracts for new works or important improvements of old ones, experiments in the construction of roads and machinery and in their management, particulars as to the business of railroads, and suggestions as to its improvement. Discussions of subjects pertaining to ALL DEPARTMENTS of railroad business by men practically acquainted with them are especially desired. Officers will oblige us by forwarding early copies of notices of meetings, elections, appointments, and especially annual reports, some notice of all of which will be published.

## THE NEW YORK, LAKE ERIE &amp; WESTERN.

This company has now issued a report to the stockholders, which differs from that to the State Engineer and Surveyor by containing a large amount of information not provided for by the latter. It is especially interesting as giving, for the first time, a definite statement of the outstanding stocks and bonds of the new company. There has always been some uncertainty about this, because the stockholders were offered, by the plan of organization, the alternative of a payment of \$3 per share of preferred and \$6 per share of common stock, with income bonds (non-cumulative) to the amount of their payments, or \$3 per share of preferred and \$4 per share of common without such bonds; and of course it could not be known, until the time for payments had expired, how many would elect the bonds. Moreover, it now appears that a considerable number elected not to pay at all, and so forfeited their stock, thereby lessening the total amount outstanding, though the new company has the right to sell all the forfeited shares. And some of the bondholders did not assent to the reorganization scheme, and do not receive the bonds of the new company, which they would have been entitled to.

There were in the old Erie Railway Company 85,369 shares preferred and 780,000 of common stock. Of these

23,372 shares of preferred paid \$3 per share for bonds, producing.....	\$70,116
58,095 shares of preferred paid \$2 per share without bonds, producing.....	116,190
81,467 shares of preferred are thus now outstanding, which yielded.....	\$186,306
3,902 shares were forfeited for non-payment.	
85,369 old number of preferred shares.	
72,982 shares of common stock paid \$6 per share for bonds, producing.....	\$437,892
698,095 shares of common stock paid \$4 per share without bonds, producing.....	2,792,380
771,077 shares of common stock are thus now outstanding, which yielded.....	\$3,230,272
8,923 shares of common stock were forfeited for non-payment.	
780,000 old number of shares of common stock.	
And the aggregate amount of stock assessments was.....	\$3,416,578
Against which have been issued income bonds to the amount of.....	508,008
Other changes in the capital account are caused by	

the provision of "prior lien" bonds to pay receiver's debts, and a slight change in the time of beginning payment on funded coupons.

To show the stock and debts of the New York, Lake Erie & Western Company and the changes produced by the execution of the reorganization scheme, we give below the stocks and various issues of bonds of the New York, Lake Erie & Western by the side of those of its predecessor, the Erie Railway Company:

	N. Y. L. E. & W.	Erie.
Common stock.....	\$77,707,700	\$78,000,000
Preferred ".....	8,146,700	8,536,900
Total stock.....	\$85,254,400	\$86,536,900
Erie Railway:		
First mortgage bonds.....	2,483,000	2,483,000
Second ".....	2,174,000	2,174,000
Third ".....	4,852,000	4,852,000
Fourth ".....	2,937,000	2,937,000
Fifth ".....	709,500	709,500
Buffalo Branch ".....	182,000	182,000
* Total Erie Railway bonds.....	\$13,338,100	\$13,338,100
New York, Lake Erie & Western:		
"Prior lien" bonds.....	2,500,000	
First consolidated, including all ling bonds.....	16,656,000	16,656,000
Second consolidated, including convertible bonds.....	24,180,000	24,400,000
First consolidated funded coupons.....	3,615,440	
Second ".....	8,520,651	
Income bonds.....	508,008	
Total.....	\$69,318,203	\$54,394,100
Total stock and bonds.....	154,572,603	140,931,000

\* There has never been any default on these.

† Not issued yet. They are not to exceed this amount.

There is, thus, an increase of nearly \$15,000,000 in the funded debt through the reorganization scheme, representing funded coupons and assessments on stock. A part of this has been available for improvements of and additions to the property, but a considerable part has been applied, substantially, for interest, which the company has been unable to pay from its current net profits.

Of the new company's debt, \$508,008 is in income bonds, on which the interest does not become due unless there is a surplus of net earnings over the interest on the other classes of bonds, and full interest on a large part of the other issues does not become due for some time to come.

Mr. Little, the Auditor, gives a very clear and valuable table in the report, which shows the amount of interest which will fall due on each class of bonds each year until full payment is resumed on all the issues. This table, however, does not include interest on the "prior lien" bonds, which are not to exceed \$2,500,000, but the exact amount of which cannot be known until the final close of the receivership, for the debts and expenses of which these bonds are to be issued. We give below the total amount of interest which will become due each year, to which must be added about \$175,000 a year each year hereafter for interest on the prior lien bonds:

Yearly Interest Due on New York, Lake Erie & Western Bonds.	1877.	1878.	1879.	1880.
1877.....	\$1,047,104.50	1,881,882.10	4,229,078.10	4,229,078.10
1878.....	1,881,882.10	2,050,084.82	4,229,078.10	4,229,078.10
1879.....	2,050,084.82	3,087,878.10	4,229,078.10	4,229,078.10
1880.....	3,087,878.10	4,314,884.08		

For the year covered by the report, ending Sept. 30, 1878, the net earnings, after paying all taxes, legal expenses and rentals—all charges but interest on bonds—amounted to \$3,907,345.18, which was more than twice as great as the interest that fell due in that year under the reorganization scheme, but not so much as the amount that will fall due in 1880 and after. The safety of the new company, therefore, depends on its success in increasing its yearly profits.

To make larger profits there must be more business, higher rates, or smaller working expenses. The first two conditions the company cannot greatly change. It will do its best, doubtless, to get more traffic and better rates, but it and all the other railroads have always been trying for these, with indifferent success. The traffic depends chiefly on circumstances entirely beyond the control of the railroad company. It can carry much only when there is much to carry. The change of gauge, however, breaks down the obstacle which has hitherto prevented traffic from reaching this road freely, and the New England connection will open a new source of traffic. An improvement in rates was secured last year by the trunk line agreement with regard to west-bound traffic, and the execution of one with regard to east-bound traffic would have a considerable effect, doubtless, on the average profits received from this large traffic. An addition of one mill per ton per mile on the through east-bound traffic would probably add something like \$300,000 to the profits of this road, and this would be an advance of only five cents per 100 lbs. on the average rate from Chicago to New York, which, considering what the actual rate was most of 1878, ought to be perfectly practicable. But this the New York, Lake Erie & Western cannot secure by its own efforts. The reduction of expenses depends upon the character of the company's staff and the improvement of its appliances for conducting traffic, aside from the prices of wages and materials. The latter seem not

likely to be lower. The staff is substantially the same—except that it has a new head—that it has been for several years, composed of capable, intelligent, wide-awake men, and on that account not likely to do much better hereafter than they have heretofore with the same appliances. The necessary increase of earnings, therefore, must be looked for chiefly in improved appliances—more economical motive power, better tracks, more sidings, the completion of a second track for the main line, better shops and shelters for rolling stock, and provisions for handling freight more economically at the termini. Other things which the company cannot affect by its action may profit it more than these improvements, possibly; but what it can do is to make the improvements which will be sure to reduce expenses by an amount greater than interest on the cost of the improvements. Just what these improvements are, of course only those intimate with all the details of the traffic and the operation of the road can point out. It is easy to over-estimate them and their effect, because there is usually a disposition to count on a larger traffic when a road has been prepared to do it economically; but there must be many particulars in which improvements can be made on the New York, Lake Erie & Western which would cause a great saving in the cost of conducting the existing traffic—otherwise all the other trunk lines have acted very absurdly in spending millions and tens of millions in improving their roads.

The present management, however, is not likely to make any extravagant expenditure on this road, if for no other reason, because it has a very limited amount to spend. President Jewett estimates that this will amount to about \$6,000,000 down to Sept. 30, 1880, arising from the assessments paid on stock (immediately available, and now indeed largely expended), the excess of net earnings over interest due that may accrue before that time, and the proceeds of \$820,000 of the new consolidated mortgage that will remain in the company's hands after transferring what will be due to former holders of Erie second consolidated bonds. The bonds now bear too low a price to make it advisable to sell them. The surplus net earnings Mr. Jewett thinks it not safe to estimate at more than \$2,500,000 for the two years. Should the net earnings be the same as for 1877-78, the surplus applicable to improvements will be less than \$1,800,000. The third rail and rolling stock already obtained or contracted for absorb about \$1,780,000, and there remains 110 miles of second track to be completed and paid for, which can hardly be postponed, and is indeed, we believe, already provided for, besides the other perhaps less indispensable improvements. After the second track is completed probably the company will have exhausted what is left of the stock assessments, and will have to wait to make other improvements until it has accumulated surplus net earnings. Considerable may be expected, however, from the improvements already completed or under way, and a good deal can be done with six millions, or less, in these days, even if not nearly all that the Erie needs.

In closing his report Mr. Jewett says: "The position of the company's property for commanding an increase of travel and traffic has a promising future. It but remains for the shareholders to provide sufficient money to place their property on a par in all respects with competing lines, and then—with an honest and intelligent administration of their property—the ultimate value of every description of security or stock can scarcely be questioned."

Now, if the New York, Lake Erie & Western in the last year had been able to carry its traffic at the same cost per ton and per passenger per mile as the Pennsylvania in 1877 (which has the lowest cost for freight of all the trunk lines), its profits would have been \$91,370 greater from passengers and \$1,494,500 greater from freight than they actually were. It is hardly to be expected that with any improvements it will be able to carry at less cost than the Pennsylvania. The addition to the net earnings of \$1,576,000 so saved by cheaper working would have made the surplus (above rentals) net earnings about \$5,483,000. This exceeds full interest on all the mortgage bonds provided for by just about \$1,000,000. A trifle of this would go for interest on the income bonds, and the balance would pay 7 per cent. on the preferred stock, and leave nearly \$400,000 available for a dividend on the \$77,107,700 of common stock—equivalent to a trifle more than one-half of one per cent. This would give a "value" to the common stock, without doubt; but perhaps not such as would satisfy the holders. But for anything more than this, apparently they must depend upon increased traffic or higher rates, or both. Some increase in traffic they are likely to have, and a increase in the average freight rates is at least possible. If the increase in



traffic is very large, however, then the average rate is quite as likely to fall as to rise, because this railroad's chief competitor will not need much larger profits than it has been getting. The fact is, the capital account of this company amounts to \$273,000 per mile of road owned, \$124,000 of which is in bonds; and the road can make very good profits and yet have little more than enough to pay interest on these bonds. To earn dividends on the preferred stock may become easy when the road is improved, but the \$138,000 of common stock per mile will probably have to be contented with very small dividends, if it gets any. At least it will take good luck as well as good management to give it anything more.

#### New York Grain Receipts as Affected by the Canal and the Railroads.

The Erie Canal has been useful enough to the state and city of New York—to the city especially—to do without the unfounded claims for it made by the Canal Auditor and the State Controller in their recent reports. One would gather from these reports that by the canal alone has the position of New York been maintained—that is, of the growth of traffic more than the old proportion has been done by the canal. Just the reverse of this has been true. The canal has about held its own, and the increase in the traffic, even of the kinds which are done by canal, has come chiefly from the railroads. So far as east-bound freight is concerned, the canal carries no important part of any staples except grain and lumber. The important article of flour, even, goes almost entirely by rail, and the provisions brought to the seaboard by canal would hardly be missed from the aggregate of the New York receipts. Now for the past seven years the receipts of grain at New York by canal and by rail have been:

Year.	By Canal.	By Rail.	Total.	P. c. by Canal.
1872.....	52,135,946	21,869,969	75,025,915	70.8
1873.....	48,500,045	25,172,129	73,332,174	65.8
1874.....	50,575,509	35,745,754	86,321,263	58.6
1875.....	39,017,174	34,325,142	73,342,316	53.2
1876.....	31,580,900	43,424,875	75,005,775	42.1
1877.....	47,935,500	35,872,918	83,808,418	57.2
1878.....	64,753,285	63,860,486	128,613,771	50.4

There has thus been but one year out of the seven that the canal has contributed so small a proportion of the grain traffic of New York. Compared with 1877, the total increase in New York receipts has been 53½ per cent.; but the increase in canal receipts was but 35 per cent., while the increase in rail receipts was nearly 80 per cent. Or, taking the quantities instead of the percentages:

The total increase in New York grain receipts was.....	44,805,353 bushels.
Of which the increase in canal receipts was.....	16,817,785 "
While the increase in rail receipts was.....	27,987,568 "

While the New York railroads thus increased their deliveries by this amount, which is 78 per cent. of their 1877 deliveries, the receipts of its three chief rivals, Philadelphia, Baltimore and Boston (which are wholly by rail), increased from 65,011,598 to 90,680,339 bushels, or by 34,668,741 bushels, equalling 53½ per cent. If the increase by the New York railroads had been no greater in proportion than that by the canal, the total New York receipts in 1878 would have been less than they actually were by 15,500,000 bushels, and if the increase by rail had been no greater to New York than to Baltimore, Philadelphia and Boston, then the receipts at New York would have been nearly 9,000,000 bushels less than they actually were. Taking the grain business as a whole, New York certainly has reason to be satisfied with the results of the year 1878, so far as they were caused by the railroads. The aggregate increase at its three chief rivals was substantially the same in proportion, it is true, as at New York (53½ against 53½ per cent. over 1877); but five-eighths of New York's increase is due to its railroads. And if we leave the canal aside altogether, as if not affected by the railroads and likely to carry what it gets under any circumstances, still New York appears to have got a larger proportion of the rail grain at the four ports in 1878 than in 1877.

The rail deliveries at the four ports in 1877, were.....	100,884,516 bushels.
Of which New York received 35.1 per cent., or 35,872,918 "	
The rail deliveries at the four ports in 1878, were.....	163,540,825 "
Of which New York received 39 per cent., or 63,860,486 "	

Now, not only is New York's proportion of the rail grain larger in 1878 than in 1877, but it is larger than in any other year since 1871 except two—1874 and 1875—the percentage of the aggregate rail receipts at the four ports which arrived at New York having been:

P. c.	1872	P. c.	1876
1872.....	34	1876.....	37
1873.....	38	1877.....	35
1874.....	45½	1878.....	39
1875.....	44		

Considering the enormous increase of the total grain movement in 1878, and the comparatively slight increase in the deliveries by canal, it was hardly to be expected that New York would retain its rank as a

grain receiver. It has only done so, as we have seen, by a much greater rate of increase in rail deliveries there than at the other markets.

#### In What Distance Can a Train be Stopped by Brakes?

Although this question has been the subject of many experiments, during the past fifteen or twenty years, it is believed that the essential principles which govern it are still very imperfectly understood by most railroad men. This fact will be the reason for treating the subject in a somewhat elementary way. By doing so it will be much easier, too, to follow the reasoning in an article of this kind than it would be if the latter consisted largely of references only to general principles. Judicious skipping will prevent what follows from being tedious to those familiar with the laws of physics which will be explained.

To get a clear idea of the problem, let us ask, first, how much force or power, in the ordinary acceptance of those words, will be required to stop a train when it is running at a given speed of say 10, 20, 30, 40 or 50 miles per hour. Presented in that way, the question appears very vague and confused. If we ask how much horse-power would be required to stop a train, the problem begins to appear a little more comprehensible, because we can imagine one or more horses exerting their power to resist its motion. In order to make the term horse-power mean something definite and exact, engineers, ever since Watt's time, have defined it as a power equivalent to that required to raise 33,000 lbs. one foot high in a minute. It will take just as much power to raise one pound 33,000 feet high, or 66,000 lbs. half a foot high. Of late years scientific men have adopted the term *foot-pounds* to express the power, or rather the amount of *energy* or *work*, as it is now called, which is exerted in raising one pound one foot high, so that a horse-power is the exertion of 33,000 foot-pounds per minute. Let us, then, abandon the use of the term *force* and *power*, and use the more exact designation of *foot-pounds* and ask how many foot-pounds of *work* or *energy* must be exerted to stop a train at a given speed.

It is evident that when a train or car is running at any speed it has stored up in itself a certain definite amount of momentum, energy, or capacity of doing work. Thus, if a car is pushed at the rate of 30 miles per hour in front of an engine to the foot of a grade or incline of, say, one foot rise in 100 feet of length, and is then permitted to run up the grade by its own momentum, it will ascend until the resistance of the grade is equal to the energy contained in the car. Supposing the weight of the latter to be 30,000 lbs., and that it runs 1,200 feet before stopping, it is evident that at the end of that distance it will have ascended a vertical distance of 12 feet. In other words, the momentum stored up in the car at the foot of the grade was sufficient to lift its own weight 12 feet, and in doing this it performed 30,000 × 12 = 360,000 foot-pounds of work. How, then, can the energy stored up in a man be calculated?

It has been seen that if a car be permitted to run up a grade by its own momentum, the height to which it ascends the grade is a measure of the amount of work done by the momentum. Let us imagine, now, that instead of ascending a grade, the car be raised vertically—as on an immense elevator or lift—at the same speed as it runs on the track, and that when it attains a given speed the elevator should stop and the car should be permitted to ascend by its own momentum. If this experiment could be made in a vacuum so as to get rid of the resistance of the air, the height of the ascent would indicate exactly the amount of energy stored up in the car at that speed—that is, it would show just how high the momentum of the car would lift it vertically, which distance, multiplied by the weight, would give the number of foot-pounds of energy contained in the car at the given velocity. While no one has made exactly this experiment, scientific men have made a great many analogous ones to determine the velocity and energy of falling bodies. It has been found that any body will fall in a vacuum from a state of rest 16.1 ft. in the first second, and at the end of that time it will have attained a velocity of 32.2 ft. per second. In two seconds it will fall 64.4 ft., and the final velocity will then be 64.4 feet per second; at the end of the third second it will have fallen 144.9 ft., with a final velocity of 96.6 ft. per second. In other words, we have the well known law that the distance which a body falls is proportional to the square of the time, that is, it falls 16.1 ft. in one second and will fall 2 × 2 = 4 times 16.1 ft. = 64.4 ft. in two seconds, and 3 × 3 = 9 times 16.1 ft. = 144.9 ft. in three seconds. Therefore, to get the height which a body will fall in a given time, (a) square the time in seconds and multiply by 16.1; the product will be the height in feet.

If we make—

$t$  = the time of falling in seconds.

$h$  = the height of fall in feet.

$v$  = the final velocity in feet per second, the formula for this calculation becomes  $h = t^2 \times 16.1$ .

The second law of falling bodies is that the velocity is proportional to the time of falling; that is, if at the end of the first second the velocity of a falling body is 32.2 ft., at the end of two seconds it will be 2 × 32.2 = 64.4 ft., and in three seconds it will be 3 × 32.2 = 96.6 ft. Or,  $v = t \times 32.2$ .

Conversely, if we have the velocity per second of a falling body, and divide it by 32.2, it will give the time, in seconds, that it would require to attain that velocity. Or, algebraically,

$$t = \frac{v}{32.2}$$

Now, if we square the time and multiply by 16.1 ft., it

will give the height that a body must fall to attain the velocity. Or, algebraically, we would have

$$h = \left( \frac{v}{32.2} \right)^2 \times 16.1$$

$$\text{or } h = \frac{v^2}{64.4}$$

Therefore we would have this simple rule: (b) Having the velocity in feet per second, to find the corresponding height of fall, square the velocity, and divide by 64.4.

It follows from this that a body with any given upward impulse or velocity would ascend a distance equal to that from which it must fall to require that velocity.

Therefore, if a car is running at a speed of say 50 feet per second, we would have:  $\frac{50^2}{64.4} = 38.8 \text{ ft.} = \text{the height that}$

the car would ascend if projected upward at that velocity. If the car weighs 30,000 lbs., the momentum or energy stored up in it at that speed would therefore be 30,000 × 38.8 = 11,640,000 foot-pounds.

Suppose now that we have a train consisting of the following vehicles of the weights given:

Locomotive.....	60,000 lbs.
Tender.....	40,000 "
One baggage car.....	30,000 "
Three passenger cars.....	120,000 "
One sleeping car.....	50,000 "
Total.....	300,000 "

and that this train is running at a speed of 45 miles per hour, which would be equal to 66 feet per second. The height of fall or ascent corresponding to this velocity would be 67.6 ft. Consequently, the amount of momentum or energy stored up in the train at that speed would be 300,000 × 67.6 = 20,280,000 foot-pounds.

But there is another element which must be taken into account in estimating the momentum of the train. This is the revolution of the wheels.

Suppose a large wheel, like the fly-wheel of a steam-engine, to be placed on a platform car and mounted on journals, so that it could turn freely. It is evident that the momentum of the car when in motion would be increased in proportion to the increase of its weight by the fly-wheel. The momentum would not be diminished either if the fly-wheel were made to revolve. At the same time the fly-wheel would, by reason of its revolution, have a certain amount of *rotary momentum* or *energy of rotation*. This energy of rotation would not be affected either by the horizontal movement of the car. It would require just as much exertion of power to stop this fly-wheel from revolving if the car was running 50 miles per hour as it would if the car stood still. In other words, the energy of rotation of the wheel is independent of the forward movement of the car. Now this is also true of the revolution of the car and engine-wheels of a train. They all have a forward momentum or energy when the train is in motion in that direction, and also an energy of rotation. How can the latter be calculated?

The velocity of the circumference of a car or engine-wheel around its centre, or its *angular velocity*, is equal to the speed of the train. If all the weight of the wheels were concentrated at the circumference, their energy of rotation would be just equal to their horizontal momentum. But at the centre of the wheel the particles have no energy of rotation, and from that point outward it increases to the rim. There is a point called the *centre of gyration* between the centre of the wheel and its circumference, at which, "if the whole quantity of matter were collected, the angular velocity would be the same." Its position is dependent upon the form of the revolving body and the distribution of its weight. Owing to the complicated form of a car-wheel, it would be very difficult, if not impossible, to calculate its centre of gyration, and as it would lead to too much elaboration to explain how such calculations are made, it will be sufficient to say that no very material error will result if it is assumed that the centre of gyration of a car-wheel is at a distance of one-fifth of its radius from the circumference. The angular velocity of the centre of gyration would therefore be four-fifths of that of the train. If we apply rule (b) to this and square it and divide by 64.4, we will have the equivalent height which a body must fall to attain this velocity. The result multiplied by the weight of the wheels and axles will give the amount of energy of rotation. The weight of the wheels and axles may be taken as follows:

4 engine truck wheels.....	Lbs. 1,720
4 engine driving wheels.....	7,200
8 tender wheels.....	4,240
44 car wheels.....	23,320
2 engine truck axles.....	600
2 engine axles.....	1,200
4 tender axles.....	1,260
22 car axles.....	6,930
Total revolving weights.....	46,470

The velocity of our hypothetical train was 66 feet per second, four-fifths of which would be 52.8 feet, the corresponding height of fall of which would be 43.3 ft. Therefore, the energy of rotation of the wheels and axles would be 46,470 × 43.3 = 2,012,151 foot-pounds.

This added to the result of the forward momentum would make the total energy of our train, at 45 miles per hour, equal to 22,292,151 foot-pounds, which must be overcome to stop the train at that speed.

If, now, this train is running at that rate on a level and straight track, the only force exerted to overcome this momentum is the train resistance. At 45 miles per hour this would be 17.8 lbs. per ton of 2,000 lbs.,\* and just before the train would stop the resistance would be 6.1 lbs. per ton, or an average of 11.95 lbs. As the train weighs 150 tons, the

\* These resistances are taken from the table, page 590, of the "Catechism of the Locomotive."



resistance for each foot that it moved would be equal to  $11.95 \times 150 = 1,792.5$  foot-pounds; therefore, the distance such a train would run by its own momentum at a speed of 45 miles per hour on a straight and level track would be

$$\frac{22,292,151}{1,792.5} = 12,436 \text{ feet} = 2.3 \text{ miles.}$$

On an up-grade of 50 feet per mile, the resistance would be 30.85 lbs. per ton, and the train would then run by its own momentum 4,817 feet.

Let us calculate what the resistance will be on the level track if we apply the brakes to all the wheels of the train excepting those under the engine and two pairs of the six-wheeled trucks of the sleeping car. This is a more complicated question than it appears at first. Until recently it was supposed that the friction of brake-shoes on the wheels and that of the wheels on the rails were very nearly alike, and that it was from one-fourth to one-fifth of the weight or pressure on them. The experiments of Captain Galton and Mr. Westinghouse have, however, shown that the friction, or the co-efficient of friction, varies very much at different speeds, and that the friction of cast-iron brake-blocks on steel-tired wheels is considerably greater than that of steel tires on the steel rails. Thus the friction of the brake-shoes at 45 miles per hour was only one-eighth of the pressure, and at speeds of less than five miles per hour it was more than a third, averaging about one-quarter between these rates. The co-efficient of friction of the wheels on the rails at 50 miles per hour was only .04 and at 10 miles .110, averaging .071. These co-efficients were taken too at the time the brakes were first applied and the wheels first commenced to slide, and before the expiration of three seconds. After sliding that length of time the co-efficients in both cases diminished considerably. At very slow speeds it was found that the pressure required to skid the wheels was about equal to the weight of the braked wheels upon the rail. At 60 miles per hour, with three times that pressure, the wheels could not be made to slide, and at 50 miles per hour it was barely sufficient for the purpose. Although the experiments thus far reported are not entirely conclusive on this point they indicate that with a brake pressure equal to the weight of the wheels on the rails the average retarding power of cast-iron brake-shoes is about 20 per cent. of their pressure. The retarding force of wheels sliding on the rails at high speeds was less than 3 per cent. of the load on them, but gradually increased to 20 per cent. as the speeds diminished. To quote from a descriptive article of this series of experiments, published in the *London Times*, "the result was clearly to demonstrate the necessity of the application of a very high degree of brake force when running at high speeds, and also to show that this degree of force should be gradually relaxed and diminished in proportion as the train speed itself is diminished by the pressure." Mr. Westinghouse has been experimenting for some time on a "reducing valve" for diminishing the pressure on the brakes as the speed is diminished. Such an appliance would make it practicable to use much greater maximum pressure on the brake-shoes at high speeds, and without the risk of skidding the wheels at slower speeds. This device has not yet come into practical use, and the calculations for existing brakes must be based on our present practice of applying a pressure to the brake-shoes about equal to the weight of the wheels on the rails; and for such pressures the average retarding force of the brakes has been shown to be about 20 per cent. of the pressure.

The weight resting on the wheels of our train to which the brakes will be applied amounts to 233,333 lbs. As stated, if the pressure on a brake-shoe exceeds the weight which that wheel carries, including its own weight, the wheel will slide and be made flat when the speed is reduced. Therefore, it is the practice at present never to allow the pressure of the brake-shoes to exceed the weight on the wheel. The average force required to slide a wheel against a brake-shoe is equal to about one-fifth of the pressure on it. Therefore, if the pressure on the shoes is equal to the weight on the wheels to which they are applied, the resistance in this case would be

$$\frac{233,333}{5} = 46,666.6 \text{ lbs., and thus for every}$$

foot that the train runs there must be 46,666.6 foot-pounds of energy exerted to overcome the friction of the brake-shoes. This, added to the 1,792.5 foot-pounds due to the train resistance, will give the total retarding power exerted to stop the train. We would thus have 48,459.1 foot-pounds exerted through each foot that the train moves to overcome the energy stored up in it. Therefore we will have

$$\frac{48,459.1}{110} = 440$$

feet, the distance in which the train can be stopped after the brakes are applied at that speed. But it must be kept in mind that the application of the brakes does not occur instantly when the engineer turns the cock admitting the compressed air to the apparatus. An appreciable time intervenes between that act and the time when the brakes are full on. Experiments have shown that this varies from one to five seconds, with the Westinghouse automatic brake, in proportion to the length of the train and no doubt to the perfection of the apparatus used. Assuming that the average time consumed is three seconds, it will be seen that in that interval our train would run  $66 \times 3 = 198$  ft. before the effect of the brakes would retard the train, so that the distance run would be 658 ft. before it could be stopped. It is this element of quickness of application which enables one form of brake to stop a train quicker than another. In all systems of continuous brakes, it is possible to bring sufficient ultimate pressure on the brake-shoes, but the difficulty with some of them, especially with long trains, is that this pressure is not

applied quick enough. In nearly all the splendid series of experiments made in Europe recently the investigations were directed chiefly to the efficiency of brakes in the one matter of quickness of application.

It is of course true that if brakes were applied to all the wheels in a train, including the driving-wheels, the retarding power would be greater in the proportion which the weight which they carry bears to that on the wheels to which it has been assumed that brakes are applied.

While it is true that if the pressure on the brake-shoes exceeds the weight on the wheels the latter will slip when the speed is reduced, yet, as stated, at speeds of 50 or 60 miles per hour it is very difficult to skid the wheels. This is attributable to the fact that the wheels at the high speed have not only a rotative momentum, but, besides, they are caused to rotate by the forward impulse of the car. The condition is analogous to that which would exist if we were to place a pair of wheels on an axle in a lathe, and turn them by a belt whose adhesion is just equal to that of the wheels to the rails, and drive them at the same speed with which they revolve on the track at a given speed. Suppose, now, that when the wheels are so driven we can apply a brake with a screw, and with great pressure. Under these conditions it would be impossible to check the revolutions of the wheel instantly. To do this we must first overcome the energy of rotation of the wheels, and also the driving power of the belt. It is for a similar reason that the wheels of a car cannot be slid at a high speed until some considerable time after the brakes are applied, even with very great pressure. Mr. Westinghouse has, therefore, been experimenting on an apparatus which will apply a very much greater pressure to the brakes at first than would be needed to slide the wheels at a comparatively slow speed, and afterward reduce it gradually as the speed is lessened. With such a device, and by applying the brakes to all the wheels in a train, it will be possible to stop it in much less time than that indicated by the above rules and calculations.

#### The East-Bound Freight Agreement.

The Joint Executive Committee, which has charge of the execution of the plan for maintaining east-bound rates, held a meeting in New York last week, at which the Chairman, Mr. Pink, made a report in which he spoke very decidedly of the necessity of prompt and thorough organization and action, if the plan proposed at Chicago is to be executed. Two steps of some importance were taken. One was with regard to through rail-and-ocean-steamer rates, which it was agreed should be the same by all the sea-ports, and equal to the New York rate by freight steamer plus the railroad rate to New York, the steamer rate to be reported daily in order to give the basis for the through rate. That is, should the steamer rate on flour from New York to Liverpool be 2s. 6d., or 60 cents per barrel, Feb. 1, then the rate from Chicago to Liverpool that day will be \$1.30 by Portland, Boston, New York, Philadelphia or Baltimore, as the Chicago-New York rate is now 70 cents a barrel. Should, then, the steamer rate from Baltimore to Liverpool be the same as from New York that day, the railroad will receive 70 cents per barrel on that flour, instead of 64 cents, as on consignments to Baltimore. And should the steamer rate from Boston be the same as from New York that day, the rail rate to Boston will be 70 cents instead of 80 cents. This is an effort by the railroad companies to neutralize the differences in rates that may be caused by the competition of the steamers at the different ports—a competition which it will, doubtless, not be possible to prevent, even if it were desirable. Whether it can be made to work remains to be seen. The complaint usually is, that the steamers carry to and from other places for much lower prices than from New York, often not being able to get cargoes otherwise. This, probably, could be left to regulate itself, were it not that it gives occasion to cuts in the rail rates which are frequently much greater than those in the steamer rates. The steamer rates might safely be left to regulate themselves, because the steamers can abandon an unprofitable rate at will, and in the long run they will not go to the port which yields them less profits than the average, while the railroad, unfortunately, cannot change its terminus from Halifax to New Orleans, from Baltimore to Boston, so readily.

The other important decision was to leave the appointment of an arbitrator to decide as to the division of the Chicago shipments among the five roads to the presidents of the four trunk lines. This seemed likely to be a wise step, as, though the trunk lines control all the roads from Chicago, their managers have not had the active controversy over this matter which may be supposed to have made their Western representatives somewhat inflexible in their position and demands. But so far the trunk lines have had no better success than the Western roads in settling the matter. When it was, in Chicago, agreed to leave the question to an arbitrator, it was supposed that it would be settled in one way or another in a very short time. But the roads seem to have been just as particular as to the person of the arbitrator as they were as to their percentages when they were trying to agree upon the latter. Objections are made to every one proposed, and some begin to hint that the agreement to leave the matter to arbitration was made for the purpose of postponing an apportionment.

Meanwhile, most of the work remains to be done, and most of the freight coming forward is probably carried on contracts at, we suppose, as much as 10 cents per 100 lbs. below the tariff of Nov. 25, which is still nominally in force—and under which, doubtless, some shipments are made. Pools are reported in full operation at Louisville, Indianapolis, Peoria and Lafayette; they adjust the rates so as to keep

them uniform by all routes from these places, but modify them to meet the changes caused by the contracts from Chicago and elsewhere. The St. Louis roads have agreed to renew their agreement to divide shipments equally—90 per cent. to each of the five roads—and the condition of things is certainly much better than it was last year at this time.

The Joint Executive Committee is liable to be called at any time to take further steps, and an arbitrator for the Chicago business may also be appointed any day. The Cincinnati business also has to be divided, the division made some months ago not being retained. With pools at these two places, probably there would not be much difficulty in coming to an agreement elsewhere.

THE VALUE OF THE HOOSAC TUNNEL is discussed at some length by Mr. Thomas Doane in a paper contributed to the Boston Society of Civil Engineers. This value he looks for in the effect of the new line in reducing rates by competition. He does not adduce rates before and after the opening of the tunnel line, in evidence of this effect, or at least does not assert that the reductions made have been caused wholly or chiefly by the competition of the new route; but he gives a statement of the weight and the value of the freight receipts at Boston, from the Boston & Albany and the Fitchburg railroads, and then, curiously enough, estimates the value of the tunnel line in a percentage on the value of the freight, the basis of which is the statements of certain merchants, some of whom thought the new route had had considerable effect, and some that it had had none. Mr. Doane thinks that the effect has probably been equal to  $\frac{1}{4}$  per cent. on the value of the freight, which he puts at about \$185,000,000 in 1877. Thus he would make the saving to the Commonwealth by the tunnel to have been about \$925,000, or 5 per cent. on the \$18,000,000 invested in the tunnel. But a much more direct and accurate way would have been to take the weight of the freight, instead of its value. He gives the weight of the receipts at 1,077,000 tons. The shipments are probably not one-third of the receipts, but estimating them at one-half, we have a total of 1,600,000. Now, to save \$925,000 in the rates on this quantity of freight, the reduction caused by the completion of the tunnel line must have been at the average rate of 58 cents per ton, or 2.9 cents per 100 lbs. between Boston and Albany. Now the share of these roads in the average rate on east-bound freight in 1877 or 1878 has been about 6 cents; on west-bound perhaps 10 cents. If the Tunnel Line had reduced the rates by about 3 cents to these figures, then it must have caused a reduction of one-third in the through east-bound rates, and nearly one-quarter in the west-bound. Any one who knows anything about the course of freight business between New England and the West knows this to be absurd. It fact, the tunnel has had scarcely any influence on through rates—not one-twentieth as much as has the roundabout Grand Trunk. The object that it was built for, the cheapening of through freights, had been accomplished by other means long before the tunnel was completed. The only unreasonableness in these that Massachusetts could justly complain of for several years has been their unreasonable lowness, which has shifted an undue portion of the burden of supporting the railroads upon the local freights. The reduction in average rates upon the Boston & Albany and the Fitchburg roads are in no degree exceptional, but are matched in New York, Pennsylvania, Ohio and Michigan; and the difference between New York and Boston rates has certainly been just as great since the Tunnel Line was opened as before. And an improved road to Boston will not have any more effect on Boston freights than an improved one to Baltimore or Montreal. If anything should reduce the average cost and price five cents per 100 lbs. to Baltimore, without affecting the cost to Boston, the Boston rate would doubtless be reduced by that amount within two weeks, and so with any other reduction, unless the price to the other port should become permanently and unquestionably less than the bare cost to Boston. The improvement of the mouth of the Mississippi, should it effect what is claimed for it in the cost of shipments from the Northwest to Liverpool by that stream, will inevitably cause a reduction in rail rates on many staples from the Northwest to New York and Boston, and so of the Welland Canal; which latter may very likely have fifty times the effect of the Hoosac Tunnel on Boston rates, and yet injure rather than benefit Boston import and export business; because the reduction there, however great it may be, will be less than at Montreal.

THE GOVERNMENT DIRECTORS OF THE UNION PACIFIC RAILROAD have certainly made a very interesting report this year, so much so that perhaps many may disagree with the conclusion of Mr. Adams in his letter of resignation, published after a year's service and the preparation, probably, of the greater part or the whole of this report, that the office is a useless one. But certainly the functions which the government ought to exercise are hardly compatible with service in the board of directors of the company. To guard its interests as a creditor the government needs to inspect and audit; to guard the interests of the community, it may, in addition, study traffic and rates and accommodations. But this is not work which can properly be done by a board of directors.

The report of the government directors will probably surprise many. Popularly it has been supposed that more fault was to be found with the tariffs and less with the condition of the road. As to the tariffs, everything depends upon the reasonableness of the profits of the company and the interpretation of its obligations in view of its government subsidy. It is trying to make all it can, and now Congress has made such an arrangement as to the payment of the subsidy as to make that depend largely on the



amount of the company's profits. As to the condition of the road, we think the government directors err in setting the standard so high as that of the trunk lines. A railroad should in any case be adapted to do its actual business with the greatest economy, and in calculating the cost of doing the work we must estimate the interest on the cost of improvements by which working expenses may be reduced, as well as of the working expenses proper. If the Union Pacific traffic is carried at an expense of \$4,500 per mile, and by sundry improvements of road this expense could be reduced to \$4,000 per mile, still these improvements would not be justified if the interest on their cost would be more than \$500 per mile. Now the Union Pacific is a road with comparatively light traffic, which is conducted at low speeds. There is no need of the perfect condition of trunk-line tracks for this. The saving would be something, but probably nothing like the cost. If the speed were high, even with no more traffic, the advantage of a better track would be very much greater. It may be said that the company owes the community greater speed in passenger trains, for which there certainly is plenty of room. But if the company owes the community anything, we imagine that the community would rather take it out in lower fares than in faster trains. Assuming that the trains run as they ought to now, then certainly it would be very wasteful to make tracks like the Lake Shore's for them to run on. Of course it is entirely possible for the track to be so bad as to make excessive the cost of running the trains as they are; but if so, then the company will be the chief, and probably the only, gainer by mending them, and the rights of the community in the matter will not change this at all. It is altogether possible to make a railroad too good for the work it has to do.

We have published, this week and last, the whole of this report, which has had the benefit of Mr. Adams' revision. The abstracts widely published in the daily papers give a very imperfect idea of the report, and in some particulars misrepresent its tenor, and heretofore the document has not been printed in full.

AMERICAN IRON PRODUCTION, according to the preliminary (but substantially accurate) report of the American Iron and Steel Association, carefully collected by Mr. James M. Swank, the Secretary, was considerably larger in 1878 than in 1877. The production of pig is reported to have been about 3 per cent. greater, and the increase in consumption was probably as much as 8 or 9 per cent., the stocks on hand at the close of the year being much smaller in 1878 than in 1877. The increase in Pennsylvania was nearly twice as great as the total increase; but there was a considerable decrease in Ohio and Missouri. Pennsylvania's production in 1878 was 53.2 per cent. of the whole, Ohio's 15.4 per cent., New York's 9.8, Illinois' 3.4, Michigan's 3, West Virginia's 2.2, New Jersey's and also Wisconsin's 2.1 per cent. No other state produced as much as 2 per cent. of the whole. The states which show an increase are New York (1½ per cent.), Pennsylvania (9.9 per cent.), Virginia, West Virginia (50 per cent.), Wisconsin (125 per cent.) and Illinois (33 per cent.). There were just 700 blast-furnaces in the country at the close of 1878, against 716 a year before, the difference being made by the erection of two and the destruction of 18.

Rail production increased much more than pig iron production. Mr. Swank gives the total of iron and steel as 930,000 tons in 1878 against 764,709 in 1877, an increase of 21½ per cent. The total has been exceeded in this country but one year, in 1872, when the product was 1,000,000. Hitherto for a number of years the production of iron rails has decreased continually; but in 1878 there was at least as much produced as in 1877, and probably a little more. Meanwhile the production of steel has continued to increase, from 432,169 tons in 1877 to about 600,000 in 1878—about 39 per cent. The production of steel has been sufficient to lay nearly 6,000 miles of track with rails of 58 lbs. per yard, and allowing for all the new road likely to have been laid with steel, this supply would probably renew more than 5 per cent. of all the old track in the country. The total of iron and steel, after allowing for the new road, would probably renew 6½ per cent. of all the track, which is a small proportion to be worn out in one year.

THE ILLINOIS AND MICHIGAN CANAL, which connects Chicago with the navigable part of the Illinois River, now feels the competition of the railroads to such an extent that it is doubtful whether the tolls received hereafter will be sufficient to maintain it. In Illinois as in New York the constitution forbids expenditures on the canal in excess of its earnings, so that it is quite possible that the time may soon come when the canal will have to be abandoned, unless this provision of the constitution can be evaded or abrogated. This canal has, for some years, been worked chiefly by steam, with great saving, it is said, over horse power. It has been of great advantage to Chicago, first as a grain carrier, when railroads were fewer and charged higher rates than now, and since largely as a carrier of the stone used for building in Chicago. But it is short—only about a hundred miles long—and it has no trustworthy feeder at its southwestern terminus. The Illinois River is frequently navigable but a few weeks in the year, being frozen up in winter and dried up in summer. If it could be depended upon all the time the canal is open as a safe and accessible channel even for the small class of boats that ply on the canal, the Illinois & Michigan Canal would probably have a large traffic in spite of railroad competition, as it would give a cheap route between Chicago and St. Louis on which iron ore, coal, iron, lumber and grain would probably find the cheapest carriage. But unless the Illinois River can be greatly improved—and this apparently will be a costly and difficult work—it is quite probable that the canal will never earn its expenses hereafter. The State Canal Commission-

ers complain bitterly that the competition by which the railroads have destroyed the canal business has been unfair, but it is like all other railroad competition, designed to secure a business with a trifling profit which otherwise would be lost altogether.

FREE PASSES ON THE PENNSYLVANIA RAILROAD are to be greatly limited hereafter. Notice has been given that they may be issued only by the President and by such of the vice-presidents as may be authorized by him. The General Manager is to have power to issue passes only to employés, persons traveling on the company's business, and to officers of connecting roads. The Engineer of Maintenance of Way, the general agents and the division superintendents are authorized to pass their immediate employés while on duty. These officers will be furnished the passes by the general superintendents, and the former will countersign them on giving them out. "Free passes must not be issued," says the order, "except where their use will clearly subserve the interests of the company." The trouble usually is that there is a wonderfully liberal interpretation of what will subserve the interests of a company, when it comes to issuing passes.

## Contributions.

### A State Compelling Repudiation.

TO THE EDITOR OF THE RAILROAD GAZETTE:

As a Jerseyman, somewhat solicitous of the honor of his state, and a believer in the principles of its general railroad law, I am compelled to take exception to the letter of "V. P." in your last issue, as both unjust in its charges and misleading in point of fact. The law to which he refers was an amendment to the general railroad law requiring new companies upon completing their organization to deposit with the Secretary of State the sum of \$2,000 per mile of projected road, to be returned to the company as each mile should be completed. Its object was a good one, to check the formation of wild-cat companies, and to put a stop to a new branch of business which was rapidly developing—the formation of blackmailing corporations by men without character or capital, who would threaten to build duplicate lines alongside every prosperous road in the state, but who, for a sum of money, would agree to abandon a project which might at least cause serious annoyance, if not loss to stockholders. Now to a legitimate enterprise the temporary deposit of \$2,000 per mile, with the certainty of its prompt return as fast as the road should be finished, ought not to be a serious burden; contractors would be very willing to accept the necessary draft on the Secretary of State as part of their pay, and one may be pardoned some doubts as to the "sound and prosperous condition" of a company which cannot raise \$2,000 per mile.

As a matter of fact, no very serious objection was made to the passage of the amendment, and very little has been said against it since, except by a few interested parties. One experiment in the way of building a parallel competing or blackmailing line advanced so far as the completion of the road, the result being serious loss to the old road, and the probable utter loss of the money put in the new one. There was, indeed, a reasonable doubt as to whether the amendment could be made to apply to companies organized before its passage; this the corporation to which "V. P." refers could easily have tested in the courts, but it has never chosen to do so, preferring to die a silent and repudiating martyr, as it were, rather than to pay its \$2,000 per mile under protest, or even to fee a lawyer to begin the necessary suit.

JERSEYMAN.

WOODSIDE, N. J., Jan. 13.

### The Slide-Valve and Link Motion.

ALBANY, Jan. 6, 1879.

TO THE EDITOR OF THE RAILROAD GAZETTE:

It would appear that Mr. Charles A. Smith in his valuable article on the link motion in the last issue of the *Gazette*, takes no account of the fact that the ends of the eccentric rods in ordinary locomotive practice do not take hold of the link on the centre line, but some distance back of it, in order to allow the lower rocker pin to come opposite the eccentric rods.

This causes a curious "over-end" motion, which has its effect on the motion of the valve, and which, if not allowed for, would disturb the accuracy of Mr. Smith's rules.

It is to partly counteract this movement, which causes much of the "slip" of the link-block, that the link-hanger is usually connected back of the link arc, and not upon it, as Mr. S. recommends.

It might perhaps be better in some cases, as has been done in Europe, to connect the eccentric rods to the top and bottom of the link, and on its centre line; and as the rods could not then be brought opposite the rocker pin, to give the eccentrics enough more throw to give the valve the proper travel in full gear.

CHAS. L. PALMER.

### "A Simple Method of Laying Out Curves."

TO THE EDITOR OF THE RAILROAD GAZETTE:

Your correspondent, J. O. B., in giving his simple method of laying out curves, states for a fact, that "a curve cannot be flattened at one point without being rendered sharper at some other point."

In case he had 40 degrees of curvature to dispose of, and a determined rate of 4 degrees per 100 feet, would it sharpen the curvature at any point to change the disposition of it to 36 degrees of the amount in a 4-degree curve, 2 degrees in a 2-degree curve, and 2 degrees in a 1-degree curve? Or, say, 36 degrees of the curve as contemplated in a 4-degree curve,

and the balance in hyperbola at either end? I don't see where the sharpening comes in.

As to the mechanical work in laying of the curve, it may be all true that "there is no method so rapid or accurate for this purpose as by the theodolite." Still, when a fellow is hard pushed he can make a shift with one of Stackpole's transits—and I have even known a tolerably fair curve to be run in with one of Young's best instruments, that did not seem to show much inaccuracy to the naked eye. It might have been tempting Providence—and possibly the case was only justified by the fact that theodolites were scarce where the necessity arose—and so few people, from lack of opportunity, know what a theodolite is when they see it.

W. H. C.

WAMEGO, Kan., Jan. 11, 1879.

### The Cost of Keeping Account of Car Mileage.

ST. LOUIS, Jan. 8, 1879.

TO THE EDITOR OF THE RAILROAD GAZETTE:

In the *Gazette* of Dec. 13, under the heading "Editorial Letters," you give the cost of the Car-Accounting Department of this road as being about \$5,000 per annum. This is a mistake. It will not exceed \$3,600. Please correct in your next issue and oblige,

M. SWEENEY,

Car Accountant, St. Louis, Iron Mountain & Southern Railway.

### Does the Hoosac Tunnel Pay?

[Paper read before the Boston Society of Civil Engineers by Thomas Doane, C. E., Oct. 18, 1878.]

The civil engineer finds his field of labor and usefulness principally in the construction of public works. There is, however, no reason why he should not, as an engineer and especially as a citizen, enter into that higher field where the relation between cost and the end to be attained are considered, and discuss the economic and commercial features of public enterprises.

One of the most difficult and costly works in which the people of Massachusetts have been engaged is the building of the Hoosac Tunnel. It is a work about which more has been written and said than about any other thing with which they have had to do. It has met with unreasonable reasoning and unavailing ridicule, and has overcome all. It has been talked up and talked down, voted up and voted down; it has been stopped and begun, and killed and made alive over and over again. It has cost much money—much more than if built under the patronage of an empire. If a thing is valuable, as it usually is, in proportion to its cost and the difficulties overcome in getting it, then the Hoosac Tunnel can hardly be overvalued or appreciated.

Latterly this work has been dragged into politics. The Republican party has been accused of throwing away eighteen millions of dollars, or at least of foolishly investing it. The only ground for such an accusation grows out of the fact that the Administration of Massachusetts has been uniformly Republican. It has never been a political party measure. All parts of the state have favored its construction. It has been especially advocated by the people along what is now known as the Hoosac Tunnel Line. Even the people of Cape Cod have talked and voted for it. They have been largely interested and engaged in ocean transportation, and have clearly understood the value of competition in land transportation. It has met with determined, individual and corporate opposition, but is at last completed.

The people of Massachusetts are accused of doing a thing which had better not been done, which never has paid any return of any account, and which never will or can.

Let us turn our attention for a little to an examination of this matter. We shall perhaps be led into the high regions of speculation and probabilities, but the laws governing them are not less certain in the long run than those which govern in the more easily understood regions of philosophy and mathematics.

An entering upon this discussion at this time, with a statement of a few material facts, may lead to further discussion, and to such a course on the part of the people of this Commonwealth as to secure to themselves now and forever the best results of so great a work.

On the 25th of February, 1825, the people of Massachusetts in Legislature assembled passed resolutions to appoint commissioners "to ascertain the practicability of making a canal from Boston harbor to Connecticut River" and "of extending the same to some point on the Hudson River in the state of New York, in the vicinity of the junction of the Erie Canal with that river." Under these resolutions, Nathan Willis, Elihu Hoyt and H. A. S. Dearborn were appointed commissioners. They reported to the Legislature between the 9th and 11th of January, 1829, and in it they advise a tunnel through the Hoosac Mountain for a canal. The earliest allusion to it in point of time seems to have been in a report to these commissioners by their Engineer, General Ephraim Hoyt, dated at Deerfield, Sept. 20, 1825. He thus spoke of it and the Deerfield River valley: "In general, the banks of the river through which the river has its course are composed of earth and rocks, by no means difficult to excavate, and were it not for the lofty Hoosac, a canal might be constructed to unite the Connecticut and Hudson, at the ordinary expense. A tunnel four or five miles through the mountain, composed of primitive rock, would be a Herculean task—probably too great for the contemplated object."

These commissioners unite in recommending a tunnel, and make an estimate of its cost in the following words: "As it is highly important there should be sufficient width to admit of a towing path, and afford a free passage for the boats, it is proposed to make the tunnel through Hoosac Mountain twenty-five feet wide and thirteen and a half feet high; the transverse section of which is thirty yards; being larger in the clear than either of those in Pennsylvania or Great Britain." Taking it for granted that the excavation will be entirely through rock, but of a character which will make the expense a mean of the three in Pennsylvania, that sum might be taken as the cost. But to put it beyond a doubt, the highest price which any tunnel has cost per cubic yard will be assumed, viz., that of Lehigh. In a tunnel four miles in length of the size named, there will be 211,200 cubic yards of stone to excavate, which, at \$4.36 per cubic yard, amounts to \$920,832. Thus it appears that the construction of a tunnel will be \$1,169,168 less than the expense of crossing the mountain in Vermont by locks."

On page 130 of the report of these commissioners it is found that tunnel work then being done by the Lehigh Coal Company in exceedingly hard blue granite was costing at the rate of \$4.36 per cubic yard, on a basis of double gangs with wages of men at 83 cts. per day, which "sum includes the cost of powder, tools and all other charges."



It will perhaps be interesting to compare this estimate of cost made 50 years before with the actual cost.

The cost of the tunnel alone has been inside of.....\$10,000,000  
The area of the smallest section of the tunnel is.....49.16 sq. yds.  
The price of labor was about.....\$2.25 per day.  
Triple gangs of laborers were used.

The length of the tunnel is.....4.75 miles.

With an increase of cross section, it would be fair to reduce the price per yard of excavation. The area given above as 49.16 square yards is the smallest or sound rock area. There is nearly half a mile with thick masonry and an insert on bad bottom, and a mile more with masonry on rock bottom, both giving a clear space of 36 feet wide with semicircular roof, and very largely increasing the rock excavation area. It will probably be entirely fair to offset this increase of excavation against the reduced cost per yard of the increased area. We then have to begin with the estimated cost by the commissioners of \$920,832.

The increase of section from 30 to 49.16 sq. yds. will increase cost to.....\$1,508,936  
The increase in wages of miners from \$0.83 to \$2.25 will increase cost to.....4,090,489  
The increase in length from 4 to 4.75 miles will increase cost to.....4,857,454

If the bad character of the rock, then unforeseen, and the large amount of masonry required, with the sinking of two shafts, be considered, the original estimate, founded on cost in a hard, firm rock as it was, comes tolerably near the truth.

These commissioners recommended an enlightened policy and enterprise, with friendly competition, in words quite as eloquent and appropriate as any which have since or may now be written. They say (page 157):

"The discoveries of Columbus and the voyage of Vasco de Gama have wrought as great changes in the political world as the researches of Copernicus, Galileo and Newton have in the scientific. The human mind appears to have expanded as the sphere of its action has been enlarged, and the governments of nations, participating in the more enlightened views by which individual enterprise is directed, have induced a policy which quadrates with the progressive genius of the age. Instead of a few neighboring kingdoms, the whole globe has become the field of commercial adventure, and now, as during all time, the most successful competitors in navigation among the nations are the most prosperous and renowned; not directly from that cause, but agriculture and the mechanical arts have been simultaneously encouraged to meet the demands of such a boundless interchange of products; and the reciprocal benefits to the farmer, manufacturer and merchant from the lucrative industry of each have, as alternate causes and effects, produced a general result highly beneficial to all classes of society.

"An amicable and unrestrained rivalry in the three great branches of national industry, with the generous understanding that all must be flourishing to insure the success of either is an axiom in political economy which has been sanctioned by the ablest statesmen, and has not only become the basis of statistical jurisprudence, in Great Britain and the United States, but also of international regulations. Antiquated and deleterious customs, visionary theories for the regulation of individual enterprise and the ruinous systems of exclusive monopolies have been rapidly abrogated in one European kingdom, and become the subject of profound inquiry in another. It is notorious that foreign commerce, even in Phœnicia, Athens, Venice and Geneva, could not have given them that exalted station, which each in its turn assumed, although each of these nations might be said to have been included within the walls of their emporia; but they were as distinguished for their rich manufactures as for their maritime supremacy, and when the tillers of the soil harmoniously confederate with those great interests the systems of private and public wealth, of individual happiness and general prosperity, for the diffusion of intelligence and the foundation of national glory is rendered perfect.

"But to accomplish this, the rights of every portion of the community must be respected, fostered and secured. We must then profit by the light of history, the experience of nations, and the instructive results of the gigantic efforts which have been made or are in progress on the other side of the Atlantic and most of the states in the Union for the extension of internal improvements, and thus advance the prosperity of every individual in each section of the whole Commonwealth."

The project of building a canal to the Hudson River failed largely because of the difficulty of crossing the Hoosac Mountain range, but when railroads became well established and their ability to cross mountains by ascending and descending planes had been demonstrated in the building and operation of the Worcester and Western railroads, the idea of building a railroad over the route before proposed for a canal was suggested.

The promoters and builders of the Fitchburg Railroad, after completing their road, were very determined and earnest in pushing forward the Hoosac Tunnel enterprise. They were afterward joined by the Vermont & Massachusetts Railroad interest, and largely through their endeavors the people of the commonwealth who had aided the Western Railroad to build by investing \$5,000,000 in its stock, entered upon the work of aiding the Hoosac Tunnel line, by a loan of \$2,000,000 to the Troy & Greenfield Railroad Company, secured by mortgages upon all the property of the said corporation.

This was authorized by the act of April 5, 1854. After a few years it was found that the company could not complete its road and tunnel, when the Legislature, by chapter 156 of the Acts of 1863, provided for the appointment of commissioners, and by them "for the more speedy completion of the Troy & Greenfield Railroad and Hoosac Tunnel."

The commissioners, three in number, were appointed by Governor Andrew in May, 1863. They were all railroad men, and two of them eminent as civil engineers. Over date of Feb. 28, 1863, they reported in detail (Senate Doc. 93, year 1863), and say in conclusion: "We are of opinion that the work should be undertaken by the commonwealth, and completed as early as it can be, with due regard to economy."

Before so advising, however, at their request, on the 13th day of October, 1862, the Troy & Greenfield Railroad Company surrendered, under the several mortgages, to the Commonwealth all the property of the said corporation, subject only to the right of redemption.

Before so advising, the commissioners obtained the execution of a contract between the Commonwealth and the Troy & Boston Railroad Company, the Fitchburg Railroad Company, and the Vermont & Massachusetts Railroad Company, whose roads make up the remainder of the Hoosac Tunnel line, and dated Feb. 18, 20 and 23, 1863, which, in part, reads as follows:

"Whereas, for many years, great efforts have been made by the Troy & Greenfield Railroad to finish their railroad and construct the Hoosac Tunnel, which, notwithstanding the aid granted to them by the Commonwealth of Massachusetts, they have found themselves wholly unable to accomplish, the means and credit of the company having become exhausted, and further progress having stopped nearly two years ago, with no part of the road east of the Tunnel opened for use and the Tunnel but little more than commenced; and

"Whereas, it is of the utmost importance to the rest of the railroads forming the line from Boston via Fitchburg and Greenfield to Troy that the said Troy & Greenfield Railroad and Hoosac Tunnel should be completed, by which they may become a part of a short through line to the West; and

"Whereas, The cost of constructing the said Hoosac Tunnel will be very large, and to a great extent uncertain in amount, and, at the least, wholly disproportionate to its revenue-earning value when considered as a piece of railroad of only its real length, while it will be of such vast benefit to the said whole line of railroads from Boston to Troy that its construction is warranted as a commercial undertaking; nevertheless, the railroads so interested in and desirous of its construction, and to receive such large benefits therefrom, are not in a position to undertake it or to render adequate aid to the Troy & Greenfield Railroad to enable that company to construct it, but in lieu thereof are willing to pay such just proportion of their earnings from business which may pass through said tunnel or over said road as shall be an equitable return for the benefits received;

"Now, therefore, the Vermont & Massachusetts Railroad Company and the Fitchburg Railroad Company, corporations created by the laws of Massachusetts, and the Troy & Boston Railroad Company, a corporation created by the laws of New York, in consideration that the Commonwealth of Massachusetts shall construct or complete, or cause to be constructed or completed, the said Troy & Greenfield Railroad and Hoosac Tunnel, hereby severally, and not jointly, agree and bind themselves and their assigns to the Commonwealth of Massachusetts to pay to the said Commonwealth certain sums of money as follows:

"Each of the said companies hereby agrees to pay to said Commonwealth twenty (20) per cent., or one-fifth, of all gross earnings upon such passenger and freight business as shall pass upon or over any part or the whole of the said Troy & Greenfield Railroad. For example: If either of said companies shall transport upon their railroad a ton of freight, and receive as their gross earnings for the same the sum of one dollar and fifty cents, and said freight shall pass over the said Troy & Greenfield Railroad, or any part thereof, either before or after such transportation, then this said company shall pay to said Commonwealth the sum of thirty (30) cents, and in the same proportion for the earnings from passengers, or for a greater or less amount of earnings from passengers or freight which passes over any part of said Troy & Greenfield Railroad."

It will thus be seen that before advising the Commonwealth to enter upon the construction of Hoosac Tunnel, these eminent railroad men secured contracts with all the corporations whose roads were to make up the Hoosac Tunnel line, both for the use of the road and tunnel after their completion, and also for the use of the railroads on each side of the tunnel as soon as they were built, and before the tunnel should be done. They did all they could to insure a direct return to the state for the use of the road and tunnel after they should be completed, and the people of the state entered in good faith upon the "Herculean task," relying upon an equally good faith on the part of the corporations interested and contracting.

The wisdom of these men in advising the Commonwealth to build a tunnel may, by some, be thought quite as questionable as their judgment in estimating the cost, which fell so far short of the actual.

Let us look at this moment. Their estimate was \$3,218,323. It was based on labor at the then price of \$1 per day, when it actually cost \$2.25. This difference in price of labor grew largely out of the depreciation of paper money, the country at the time being engaged in a civil war. Correcting the commissioners' estimate by the ratio between estimated and real cost of labor and we have a cost of \$7,241,227. The difference between this and the actual cost may be accounted for by the unforeseen difficulties growing out of an unsound rock, and the necessity for large amounts of masonry for lining, and out of the injurious opposition which the work encountered.

And before so advising, they secured a proposition, authorized by their respective boards of directors, from the Fitchburg and Vermont & Massachusetts railroad companies to lease that portion of the Troy & Greenfield east of the Hoosac Tunnel after it should have been built, closing with the words: "This proposition is made with the understanding that the Commonwealth shall proceed with reasonable dispatch to construct the tunnel."

And at the time the commissioners so advised, that part of the Troy & Greenfield Railroad lying west of North Adams was under a lease to the Troy & Boston Railroad Company, of New York, dated Nov. 21, 1856, they paying therefor a rent of \$8,000 per year until the completion of the Hoosac Tunnel, and then restoring the road and fixtures in good repair and condition.

On the 8th day of October, 1866, the commissioners in behalf of the Commonwealth entered into a contract, in accordance with a previous proposition, with the Vermont & Massachusetts Railroad Company and the Fitchburg Railroad Company for the use of the Troy & Greenfield east of the tunnel when it should have been built, under which it was agreed to pay the state the sum of \$90,000 annually, and also, "that when the said railroad shall have been completed as far as Shelburne Falls, they will thereafter keep said railroad in good repair as far as Shelburne Falls, ordinary wear and tear and all subsidence and damages arising from defective and insufficient construction of the road excepted, which shall be repaired by the Commonwealth; and when said railroad shall have been completed as far as the tunnel, they will keep the whole of said railroad from Greenfield to the tunnel in good repair, with like exceptions." On the 1st day of January, 1874, the Vermont & Massachusetts Railroad was leased to the Fitchburg Railroad Company till Jan. 1, 1873.

On the 9th of February, 1875, the first train was run through the tunnel.

Now, what return has been made for all this liberality on the part of the people of Massachusetts, and for all this care on the part of its agents to secure cooperation on the part of the interested corporations?

Soon after the tunnel was opened, the Fitchburg Railroad Company turned back to the state the 29½ miles of Troy & Greenfield Railroad lying east of the tunnel, upon the operation of which the Vermont & Massachusetts Railroad Company entered on the 15th of August, 1868, utterly worn out. It received a road as good as the average of second-class roads in this state, with rails never before used, and ties in part cut a few years before but not laid or used. It gave back a right of way which is imperishable, a bed of chip dirt 8 ft. wide and 6 in. thick, and two lines of disintegrated iron laid apparently to a gauge of 4 ft. 8½ in.

Chapter 77 of the Acts of 1875, approved by a Democratic Governor March 30, 1875, at Section 5, reads as follows: "The Governor, with the advice and consent of the Council, shall prescribe just and reasonable tolls, not to be raised for one year after they are thus determined, for the passage of cars with freight and passengers, mails and express matter that shall be therein to be drawn over any part of said Troy & Greenfield Railroad, both outside the said tunnel or through the same, and in fixing such tolls due regard shall be had to the commercial value of said railroad and tunnel, and to the development of business, as well as to the cost of

said tunnel. And the corporations paying the tolls prescribed shall be required to pay no other tolls, percentages or allowances whatever; but all of them shall be placed on a footing of equality. And to this end it shall be the duty of the Governor and Council, in behalf of the Commonwealth, to release from the obligations of the contract bearing date February 18, 1863, and confirmed April 29, 1863, between the Troy & Boston Railroad Company and other railroad companies, and the Commonwealth, any or all of the parties thereto, whenever they shall so request."

What were the "other railroad companies" not called by name? They were the Vermont & Massachusetts and the Fitchburg railroad companies, the former being at the time under a lease to the latter for 999 years.

Thus perished the hope of the people, and the plans of the commissioners to secure a direct and substantial return for their investments in the Troy & Greenfield Railroad and Hoosac Tunnel.

Are the garments of corporations which have thus broken faith as white as before? Has not the tone of corporate morality flattened a little as compared with the usual pitch of Massachusetts' corporate integrity? Has not right dealing, as between the old Commonwealth and the corporations to which it has given birth and to which it would do good, received a wound which much nursing or surgery and many years will hardly recover it from?

But the Commonwealth, of its own free will, released these corporations. Did it? what motive thereto? Why should it change its purposes? Every act requires a motive, and a motor. Where could the motive exist but in the corporation's soul, and who were its agents in releasing these corporations from their obligation, and what was their remuneration?

Can a corporation have a motive, or can its acts have a moral character? Do they not necessarily attach to the individuals composing the corporation, and primarily to its head and heart, as existing in its executive officers?

The question may be asked, What need of building the Hoosac Tunnel, and could not a new line have been secured over this route without building it?

To build a railroad up the Deerfield from the east end of the tunnel, and thence down the north branch of the Hoosac, would make an increase of distance of eighteen miles, and require the surmounting of a summit about 1,656 feet above the sea; or, to go by Bennington, would require also an increase of distance of eighteen miles, and the passage of a still higher summit, with steep grades, on the Bennington side. This would make the new line seven miles longer, and its mountain summit 200 feet higher than those of the Boston & Albany Railroad.

With the Hoosac Tunnel, and the line as now existing, the Hoosac Tunnel Line is 11 miles shorter than the Boston & Albany, and as the commissioners show in their report, has an advantage in grades which is equal to 9 miles more, making the distance as compared with the length and grades of the Boston & Albany 180 miles. This is a saving of 10 per cent. in operation over the Boston & Albany Railroad. It does not seem a very great hardship for the corporations contracting with the state to contribute under this showing the 20 per cent. in gross earnings which they agreed to pay. The two lines make the same rates from the West. The last Railroad Returns show that the Fitchburg Railroad receives 1.13 cents per ton per mile on freight received from other roads. Twenty per cent. out of this leaves 0.904 ct. per ton-mile.

The Boston & Albany receives but 0.85 ct. per ton-mile. The Fitchburg probably receives a larger proportion of freight than the Boston & Albany from side connections.

The report of the Manager of the Troy & Greenfield Railroad and Hoosac Tunnel for the year 1877 gives the total net receipts for that year from operation as \$97,905.94. No allowance seems to have been made for depreciation, except that the expenses include \$2,416.27 for rerolling and freight- ing old iron.

Taking the whole cost as 18 millions, this gives a return of 0.5 per cent.

But, fortunately, all is not lost as yet. The commissioners in securing their contract with the connecting corporations expected to receive 20 per cent. of their gross earnings, and also to receive the earnings of the Troy & Greenfield Railroad, which would make up another 20 per cent., that road constituting one-fifth of the whole line, thus securing a double portion for the very costly contribution of the tunnel, without which it would be impossible for the other parts to make up a through line. In this it now turns out they were mistaken. They did, however, foresee other and commercial advantages when they say, "considering the more intimate relations it may promote between Massachusetts and the West, and the benefits which such an additional facility promises to the great interests of the city and state, we are of the opinion that the work should be undertaken," etc.

Let us examine some of the ways in which the Hoosac Tunnel Line may be of benefit to the state, aside from paying direct and visible dividends, and in which the corporations in interest cannot but help to unite heartily.

One of them is in providing greater conveniences for travel, both through and local. Boston now has through sleepers without change to both Chicago and St. Louis. It has fast trains—so fast that there is no time to eat this side of the Hudson. New routes have been opened, making it possible to combine them in shortening distances, times and rates. A rivalry has already sprung up in the passenger business which has entirely grown out of another route. Though through rates for passengers have not been materially reduced, the facilities for travel and the comforts have been much increased already. These, perhaps, count but little in money, except they may lead to Boston in the way of business many who would otherwise have selected New York city.

Again, the communities living along the Hoosac Tunnel Line, and reaching the whole length of the state may reasonably expect to profit by the increase of business in the future if not in the present. The Boston & Albany Railroad in 1877 carried locally 91 million mile-tons at a rate of 1.96 cents, while the Fitchburg Railroad, whose operations extend to North Adams, or to within seven miles of the west line of the state, in 1877 carried 11 million mile-tons at a rate of 4.28 cents. It will thus be seen that the business interests along the line operated by the Fitchburg Company were paying 2½ times as much for their freightage as those on the Boston & Albany Railroad.

As the bulk of business increases, or as a more enterprising policy shall be entered upon, these rates must be reduced.

For the year 1876 the quantities were 80 millions and 10 millions and the rates 2.21 and 4.89 respectively, showing a large reduction in the rates for the one year.

Again, and it is the principal question, has any competition on freight to and from the West grown out of the opening of the Hoosac Tunnel Line?

It is known that rates have fallen off very largely within a few years. The rates per ton-mile on the Boston & Albany Railroad on freight from other roads have been as follows: for 1871 = 1.76 cts.; for 1872 = 1.54 cts.; for 1873 = 1.53 cts.; for 1874 = 1.42 cts.; for 1875 = 1.17 cts.; for 1876 = 0.96 cts.; for 1877 = 0.85 cts.

For 1877 the rate was less than one-half the rate for 1871. It cannot be claimed that competition by the Hoosac Tunnel Line has brought about the whole of this result, for



it was not opened till 1875. It is due, no doubt, to the times through which we are passing, to the appreciation in value of money, to the introduction of steel rails, and to the forced economy in doing business.

When there is a *must* a way will generally be found to do it. It is interesting, however, to notice that no substantial reduction was made from 1871 to 1875, when the Tunnel was opened, and that very large reductions have since been made. Though rates may have been the same by the two routes, there can be little doubt that competition has played some part somehow in reducing rates.

The facts indicated by these few figures on rates have made it possible for Boston to load for foreign ports a steamship per day, where but a few years ago only one in two weeks could be loaded. The large bulk of the business has been done by the Boston & Albany Railroad, and so it is still. In 1877 the Boston & Albany brought 222 million ton-miles from other roads, while the Fitchburg brought but 42 millions. Competition, however, would affect the rates on both roads about equally.

Believing, though both our Western routes connect at the present time with the New York Central only, that there is an invisible and insensible competition existing, like the insensible perspiration of the human body, without which healthy action is impossible, I have taken pains to talk with several people of Boston, representing large mercantile and manufacturing interests, about this matter.

A large dealer in hogs says there has no competition grown up by reason of the opening of the Hoosac Tunnel line, that it is not worth anything to him, and that the Grand Trunk line is the only regulator of rates.

A large operator in hops and malt, into the first of which the Grand Trunk competition does not enter, says he is much better served by the Hoosac line, and that rates of freight have fallen from \$1 per hundred to 55 cents. He thinks the competition valuable to his interest.

A gentleman engaged in flouring thinks the competition worth  $\frac{1}{2}$  of one per cent. to his business, and says that exported grains leave behind in Boston  $\frac{1}{2}$  cents per bushel for handling, which is something more than 1 per cent. in the value here.

Dealers in hides believe that the Hoosac line competition amounts to  $\frac{2}{3}$  per cent. on their value, and a gentleman dealing largely in boots and shoes would put it as high as 3 per cent. on his products.

A dealer in flour thinks the competition does not amount to anything.

Two dealers in lumber put the increased accommodation or competition at 3 per cent. and 1 per cent. respectively.

I have been at some pains to ascertain the value of the principal products of the West brought to Boston by the Boston & Albany Railroad and the Fitchburg Railroad in the year 1877.

They are laid down in the following table:

Material delivered into Boston from the West by the Boston & Albany and Fitchburg Railroads, in the year 1877.

	Quantity.	Weight, etc.	Price.	Tons.	Value.
Ashes, pot & pearl	1,021 casks	550 lbs.	\$40.00	281	\$20,841
Bacon	102,390 boxes	400 lbs.	\$20.00	32,478	4,871,700
Beef	19,790 bbls. & tcs.	300 lbs.	\$10.00	2,474	247,375
Barley	829,402 bushels	60 lbs.	\$24.87	24,887	767,107
Butter	21,247,521 lbs.		.22c.	10,924	4,674,454
Cattle	155,907 head	1,150 lbs.	5c.	80,946	8,054,652
Cheese	107,364,096 lbs.		11c.	33,982	11,410,114
Corn	7,362,718 bushels	56 lbs.	.62c.	206,156	4,564,885
Cotton	123,348 bales	480 lbs.	11c.	29,604	5,512,774
Flour	1,826,223 bbls.	200 lbs.	\$7.00	186,022	13,021,561
Hemp	3,715 bales	500 lbs.	\$40.00	928	118,600
Hops	6,000 bales from West	180 lbs.	5c.	1,440	234,000
Hams	10,000 casks	300 lbs.	\$25.00	1,515	252,475
Hides	4,525 bbls.	200 lbs.		452	75,417
Hogs, live	60,327	250 lbs.	8c.	7,541	1,246,540
Hogs, dressed	385,720	275 lbs.	8c.	46,170	5,540,520
Lumber	631,363	50 lbs.	\$4.00	15,789	2,599,252
Lumber	54,472,372 ft.	40 lbs.	\$22.50	99,787	1,225,020
Leather	661,537 sides	25 lbs.	\$2.75	8,268	1,827,751
Lumber	329,472 bundles	250 lbs.	\$2.00	41,184	9,284,100
Lard	81,342 tierces	300 lbs.	\$21.00	12,301	1,708,182
Malt	30,625 cases	100 lbs.	\$8.00	1,532	245,000
Malt	128,436 bbls.	200 lbs.	\$14c.	12,844	321,080
Malt	1,000,000 bushels	60 lbs.	\$1.10	30,000	1,100,000
Oats	3,108,128 bushels	30 lbs.	40c.	40,622	1,522,982
Pork	38,750 bbls.	200 lbs.	\$10.00	3,875	387,500
Pigs	4,834	75 lbs.	7c.	181	35,378
Rye	38,771 bushels	60 lbs.	\$7.00	1,019	32,925
Shorts	1,420,013 bushels	25 lbs.	1c.	17,825	356,503
Sheep	346,647	65 lbs.	\$5c.	11,206	1,213,294
Tongues	1,971 bbls.	200 lbs.	\$21.00	107	45,275
Tallow	27,447 bbls.	200 lbs.	\$2.75	2,745	439,122
Veals	15,941 head	100 lbs.	\$8.00	799	127,548
Wool	12,047,480 lbs.		3c.	6,324	3,704,244
Wheat	2,061,579 bushels	60 lbs.	$\frac{1}{2}$ @ \$1.35 $\frac{1}{2}$ @ \$1.38	61,847	2,610,469
Total tons				1,077,380	
Total dollars					\$92,320,025

The footings are 1,077,380 tons, worth \$92,320,025.

This table does not include any products in small quantities, and many large items may have been neglected, nor is entire accuracy claimed for it.

They consist mainly of raw material.

In the present state of things, and it has been true for many years, from one-half to two-thirds of the cars which come to Boston filled return toward the West empty.

This, in part, grows out of the fact that while most of the products of the West come to us in the raw state, those of the East returned to the West are the products of our manufactures. The value of the raw material on the average is doubled and perhaps tripled in the process of manufacture, and both bulk and weight are usually reduced, and perhaps in about the same ratio. It is substantially true that the products of one commodity are paid for in the products of another, and money enters in only to settle slight and temporary balances one way or the other.

It may, therefore, be near the truth that the value of our goods sent West equals the value of those received from the West, and the item of competition enters as fully into west-bound as east-bound business.

We may, therefore, from a commercial stand-point, double the value of the material received from the West, and have the sum of \$184,640,050 as representing the value of the freights of the Boston & Albany and Hoosac Tunnel lines carried both ways.

The only way in which west-bound cars can be filled is to build up the commerce of Boston and increase its imports, and so furnish foreign goods to our interior. If this could be done, it would not only leave its legitimate profits in Boston, but would very materially reduce the cost of freight between the East and the West.

Now, further. We have the sum of 184 millions of dollars worth of raw material and manufactured goods which we assume to have been more or less affected by competition, and which have been carried over the Boston & Albany and Hoosac Tunnel lines alone. But this represents only a portion of the business of Boston, and perhaps but a small portion. Whatever influence competition has had in reducing

freights over these two lines, it has had an equal effect, as a matter of course, upon the price of all similar manufactures whenever received from or sent to.

Again, the increase in the volume of business is like the rolling of the ball of snow, and Boston must keep the ball rolling. The text of scripture, "For he that hath, to him shall be given, and he that hath not, from him shall be taken even that which he hath," is as true of cities as of individuals.

Now what shall we say of the actual value of this now invisible competition? You have heard what intelligent business men say. Most of them put it more than 1 per cent. on the value of the goods. If it amounts to 1 per cent., the people of Massachusetts are now receiving commercially 10 per cent. dividends on the 18,000,000 invested in the Troy & Greenfield Railroad and Hoosac Tunnel. This is as much as they are now receiving on the stock owned by the Commonwealth in the Boston & Albany Railroad.

Suppose this competition to amount to  $\frac{1}{2}$  of 1 per cent., which I believe does not exceed the truth. It will amount commercially to 5 per cent. returns on the entire investment, including interest on loans of money with which to build the tunnel. A commercial return is just as good as a direct dividend. The State pays but 5 per cent. for its tunnel loans. What effect would this rate of  $\frac{1}{2}$  of 1 per cent. have on the little things which we consume?

It would reduce the price of a pound of bacon  $\frac{1}{1000}$  of a mill.  
" " " of a pound of beef  $\frac{1}{1000}$  of a mill.  
" " " of butter  $\frac{1}{1000}$  of a mill.  
" " " of live beef cattle  $\frac{1}{1000}$  of a mill.  
" " " of cheese  $\frac{1}{1000}$  of a mill.  
" " " of a bushel of corn  $\frac{3}{1000}$  mills.  
" " " of a pound of cotton  $\frac{1}{1000}$  of a mill.  
" " " of a bbl. of flour  $\frac{3}{1000}$  cents.  
" " " of a pound of ham  $\frac{1}{1000}$  of a mill.  
" " " of a thousand ft. of lumber  $\frac{11}{1000}$  cents.  
" " " of a bushel of oats  $\frac{1}{1000}$  of a cent.  
" " " of a pound of mutton  $\frac{1}{1000}$  of a mill.  
" " " of wool  $\frac{1}{1000}$  mills.  
" " " of a bushel of wheat  $\frac{1}{1000}$  of a cent.

It seems as if the simple shadow of competition in the carrying business would be able to reduce prices to the extent indicated above.

These estimates have been based upon the business of the last full year, namely, 1877. It is said that the bulk of the business of the first eight months of the year 1878 equals that of the whole of the year 1877. The results indicated in the way of commercial profit may then probably be increased 50 per cent. over those stated.

There are many things we do from which we do not expect returns so direct even as commercial ones. The City of Boston is now engaged upon an improved system of sewerage, estimated to cost four million dollars. It never expects any direct dividends upon its cost. It indeed hopes for very little from it commercially. But it does hope, through its construction, to prevent or reduce the sickness of its inhabitants, and to increase the length of the lives of its people, and so add to the number of the days of their labor and of their consequent production, and to save much money spent in physicians, medicines, in hospitals, and in benevolence toward the poor and sick who should be well and able to provide for themselves. It also hopes to add to the desirability of Boston as a place of residence, and so to the value of its property.

The stock of the Boston & Albany Railroad is selling at \$130 and that of the Fitchburg at \$122 per share. This value is based probably upon their past and prospective dividends of from 8 to 10 per cent.

In consideration of what has been done for these two lines by the people of Massachusetts, is this fair and right? They both were suppliants, and received aid: now they are proud and apparently independent. Ought not these two corporations to put their roads into the best of order and operate them on the basis of 6 per cent. dividends, and more directly than now in the interest of the people of Massachusetts?

There is another matter which the people of Massachusetts, and especially those of Boston, should look carefully after.

The Hoosac Tunnel is in the possession of the state. All other parts of these two lines are not. We see what has recently been done by an overshadowing monopoly in securing control of Western lines between Boston and Chicago, and especially in cutting off the Grand Trunk from Chicago. Such a policy is not less applicable to this end of the route, if indeed it is not already entered upon.

The Massachusetts Central Railroad is about to be or has been taken up by New York interests. The price of the Fitchburg Railroad stock may indicate operations in that direction as to that road. Its total capital is, or was in 1877, four millions of dollars. This four millions of stock controls, by lease and otherwise, its own road, the whole of the Vermont & Massachusetts Railroad and all the branches of both, and it would take but \$2,000,100 to obtain control of it all. In that event, Mr. Burt's road, from which an active and living competition is to be expected ere many months have passed, and the Troy & Greenfield Railroad, with its renowned tunnel, will become as useless as the limbs of a paralyzed man. Ought the people of Massachusetts and of its metropolis (Boston) to permit a single share of the stock of either road to pass out of their ownership?

THOMAS DOANE.

## General Railroad News.

### MEETINGS AND ANNOUNCEMENTS.

#### Meetings.

Meetings will be held as follows:  
Fitchburg, annual meeting, at the passenger station, Causeway street, Boston, Jan. 28, at 11 a. m.  
Wabash, annual meeting, at the office in Toledo, O., Feb. 19, at 10 a. m.

#### Dividends.

Dividends have been declared as follows:  
North Pennsylvania, 2 per cent., semi-annual, payable Feb. 25, in scrip convertible into stock.  
Atlanta & West Point, 4 per cent., semi-annual.  
Louisville & Nashville,  $\frac{1}{2}$  per cent., semi-annual, payable Feb. 10.  
Panama, 3 per cent., quarterly, payable Feb. 1.  
Terre Haute & Indianapolis, 4 per cent., semi-annual, payable Feb. 1.

#### Mail Service Extensions.

New or extended service is ordered over the following lines:

St. Paul & Pacific, St. Vincent Extension, service extended from Crookston, Minn., to St. Vincent, 92.10 miles. Service will be continued over the branch line from Crookston to Fisher's Landing, 12.09 miles, as a branch.

Geneva, Itasca & Sayre, service ordered from Lyons, N. Y., by Geneva and Itasca to Sayre, Pa., 92 miles, replacing former service between Geneva and Itasca.

Chicago & Northwestern, Rochester & Northern Minnesota

Branch, service ordered from Rochester, Minn., to Zumbrota, 26.12 miles.

#### Foreclosure Sales.

The Somerset & Mineral Point road was sold under foreclosure, Jan. 8, by Isaac Kaufman, Trustee, and bought by Christian Long, the chief stockholder, for \$6,000. The personal property was also sold at sheriff's sale and bought by Mr. Long for \$20. The road is nine miles long, from the Pittsburgh & Connellsville at Mineral Point, Pa., to Somerset; its debt consisted of \$50,000 first and \$95,000 second mortgage bonds.

#### Export Rate Meeting.

The committee appointed at the recent meeting of the Trunk and Western lines met in New York, Jan. 15, with the representatives of the principal European steamship lines, for the purpose of adjusting through rates on freight for export. No agreement could be reached, however, and a joint sub-committee was appointed to consider the questions involved and see if some compromise could be reached.

#### ELECTIONS AND APPOINTMENTS.

Atchison Union Depot Co.—The directors have elected L. W. Towne President; W. F. Downs, Secretary and Treasurer.

Boston, Barre & Gardner.—Mr. Charles F. Brigham is appointed Master Mechanic in place of Mr. D. T. Davis, resigned. The appointment dates from Dec. 27.

Buffalo, New York & Philadelphia.—Mr. George S. Gatchell has been appointed General Superintendent, in place of Wm. Robinson, resigned. Mr. Gatchell was Assistant Engineer of the road from 1865 to 1868, and has been Chief Engineer since 1871. He was First Assistant Engineer of the Rochester & State line from 1868 to 1871, and also last year located and built the Olean, Bradford & Warren and the Kendall & Eldred roads.

Central of Georgia.—At the annual election in Savannah, Ga., Jan. 6, the following directors were chosen: W. M. Wadley, W. B. Johnston, E. C. Anderson, G. M. Sorrell, W. W. Gordon, H. H. Epping, John R. Wilder, Andrew Low, Moses Taylor, J. J. Gresham, George Cornwell, J. R. Raders, C. I. Brown.

Champlain Transportation Co.—At the annual meeting last week, the following directors were chosen: Isaac V. Baker, Comstock's Landing, N. Y.; Alvin I. Inman, Crown Point, N. Y.; John B. Page, Z. V. K. Wilson, Rutland, Vt.; Vernon P. Noyes, Burlington, Vt.; George B. Chase, Boston; Le Grand B. Cannon, New York. The board elected Le Grand B. Cannon, President; Vernon P. Noyes, Treasurer.

Charlotte, Columbia & Augusta.—At the late annual meeting the following directors were chosen: John B. Palmer, Reuben Foster, A. B. Andrews, R. Y. McAden, S. B. Alexander, A. B. Davidson, F. W. McMaster, James H. Rion, A. B. Springs, J. N. DuBarry, W. F. Clyde, A. S. Buford, L. D. Childs, J. J. McLure, W. E. Jackson, J. O. Mathewson, Josiah Sibley, David Dickson; J. U. Meyers, Mayor of Augusta, Ga., is a director *ex officio*. The board elected John B. Palmer, President; A. S. Buford, Vice-President; C. Bouknight, Secretary; John C. B. Smith, Treasurer; T. M. R. Talcott, General Superintendent; T. D. Kline, Superintendent; John Craig, Auditor and Assistant Secretary; Sol. Haas, General Freight Agent; J. R. Macnardo, General Passenger Agent.

Chicago & Alton.—A dispatch from Bloomington, Ill., says that Mr. A. A. Ackerley, late Assistant, has been appointed Acting Superintendent of Machinery, in place of John A. Jackman.

Cincinnati & Portsmouth.—At the annual meeting last week the following directors were chosen: Henry Brachman, D. K. Este, W. H. Corbly, A. A. Colter, A. Hopper, E. G. Penn, W. W. Duckwall, Joseph Clark, L. B. Miles. The board elected Henry Brachman President; D. K. Este, Vice-President; M. Simmons, Secretary and Auditor; A. A. Colter, Treasurer; W. H. Corbly, Superintendent; O. M. Perin, Chief Engineer.

Cincinnati, Rockport & Southwestern.—At the annual meeting in Mitchell, Ind., Jan. 7, the following directors were chosen: Joseph Kinsey, E. V. Cherry, J. F. Mann, G. H. Eager, D. Clark, W. O. Rockwood, Aquila Jones, M. G. Moore, C. H. Salin. The board elected Joseph Kinsey, President; E. V. Cherry, Secretary; W. O. Rockwood, Treasurer.

Columbus, Washington & Cincinnati.—At the annual meeting last week the following directors were chosen: J. W. Merchant, J. M. Hussey, J. H. Kirk, F. McKay, A. McKay, John Ogleshe, O. Lamar, C. A. Haughey, William Stewart, A. J. Van Pelt, Joshua Brown, S. L. Haines, C. A. Perkins.

Dayton & Union.—At the recent annual meeting the following directors were chosen: James McDaniel, F. H. Short, J. H. Devereux, G. W. Rogers, Preserved Smith, F. H. Poppleton, R. M. Shoemaker, H. B. Hurlbert, Henry Lewis. The board elected James McDaniel President; G. W. Rogers, Secretary and Treasurer.

Delaware.—At the annual meeting in Dover, Del., Jan. 9, the stockholders elected the following directors: S. M. Felton, Isaac Hinckley, Andrew C. Gray, Charles Warner, Joseph Bringham, Edward Bringham, Jr., Isaac Jump, H. B. Fiddeman, Manlove Hayes, Alexander Johnson, James J. Ross, Albert Curry, J. T. Moore; Treasurer, Manlove Hayes. The board elected S. M. Felton, President; Manlove Hayes, Secretary.

Delphos, Bluffton & Frankfort.—Mr. W. J. Sherman is Chief Engineer of this road, as well as of the Delphos & Kokomo.

Delphos & Kokomo.—The officers are as follows: President, C. A. Evans, Delphos, O.; Vice-President, H. C. Mills, Willshire, O.; Secretary, J. H. Toland, Delphos, O.; Treasurer, D. W. Evans, Venedocia, O.

The directors chosen at the annual meeting, Jan. 6, are as follows: C. A. Evans, Oscar Jettig, Delphos, O.; John A. Smith, Buena Vista, O.; D. W. Evans, M. H. Morgan, Venedocia, O.; H. C. Mills, J. F. Schaffner, Willshire, O.

Jeffersonville, Mt. Sterling & Columbus.—At the annual meeting last week the following directors were chosen: S. McClintick, George Kioms, William McCafferty, S. W. Brown, W. Hayes, Jesse Hagler, S. F. Rock. The board elected George Kioms, President; S. F. McClintick, Vice-President; O. W. Marshall, Secretary; J. J. Looftorrow, Treasurer; S. F. Rock, Chief Engineer.

Lancaster & Reading.—At the annual meeting in Lancaster, Pa., Jan. 6, the following were chosen: President, R. W. Shenk; Directors, C. A. Bitner, F. V. A. Caben, Dr. Henry Carpenter, George W. Hensel, Daniel Herr, C. M. Hess, Amos Hollinger, John Keller, W. H. Kemble, A. H. Peacock, W. L. Peiper, John D. Skiles; Secretary, Wm. Leaman. The road is leased to the Philadelphia & Reading.

Longview & Sabine Valley.—At the annual meeting in



Longview, Tex., Jan. 4, the old board was reelected as follows: Brad. Barner, Eli Barner, Samuel Cundiff, C. C. Hanks, George D. Harrison, J. H. McCauley, T. S. S. Young. The board reelected Brad. Barner, President; George D. Harrison, Vice-President; Eli Barner, Secretary and Treasurer.

**Missouri, Iowa & Nebraska.**—At the annual meeting, held Jan. 6, the following directors were chosen: A. J. Baker, F. M. Drake, J. A. Talbot, Centerville, Ia.; James Fitzhenry, Henry Hill, E. Walker, Warsaw, Ill.; A. L. Hopkins, Toledo, O.; B. E. Smith, Columbus, O.; F. Lovejoy, Philadelphia; George J. Forrest, Wm. Gebhard, Charles A. Secor, A. B. Stone, New York. Messrs. Hopkins, Lovejoy, Forrest and Gebhard are new directors.

**Montgomery & Eufaula.**—Mr. B. Dunham, Superintendent, having resigned, Mr. Lyman Wells, Treasurer, is appointed also Assistant Manager, and Mr. R. A. Tarver, General Freight Agent, is appointed Master of Transportation also.

**New York & Brighton Beach.**—The directors of this new company are: J. T. Banker, L. G. Biglow, W. P. Chapman, C. H. Dearing, W. H. Hoyt, A. A. Marsh, W. P. Shearman. The officers are: A. A. Marsh, President; W. P. Shearman, Vice-President and Treasurer; J. T. Banker, Secretary.

**New York Elevated.**—At the annual meeting in New York, Jan. 14, the following directors were chosen: Ashbel H. Barney, Alfred S. Barnes, Heber R. Bishop, Benjamin Brewster, Charles J. Canda, James A. Cowing, David Dows, Cyrus W. Field, Edward M. Field, Josiah M. Fiske, John H. Hall, Daniel A. Lindley, John D. Mairs. The board reelected Cyrus W. Field President; F. E. Worcester, Secretary; James A. Cowing, Treasurer.

**North Pennsylvania.**—At the annual meeting in Philadelphia, Jan. 13, Franklin A. Conly was reelected President and the following directors chosen: John Jordan, Jr., William G. Ludwig, Edward C. Knight, Alfred Hunt, Thomas Smith, Arlo Farlee, James H. Stevenson, Jacob Riegel, Richard J. Dobbins, Charles A. Sparks, Edward H. Fittler, Thomas P. Stotesbury.

**Norwich & Worcester.**—At the annual meeting in Norwich, Conn., Jan. 8, the following directors were chosen: A. F. Smith, John F. Slater, Norwich, Conn.; Edward L. Davis, F. H. Dewey, George W. Gill, Charles W. Smith, Worcester, Mass.; W. F. Weld, Boston; W. Bayard Cutting, New York. The only new director is Mr. Cutting, who succeeds Robert Bayard, deceased.

**Philadelphia & Reading.**—At the annual meeting in Philadelphia, Jan. 13, Mr. Franklin B. Gowen was reelected President, with the following Managers: John Ashhurst, A. E. Borie, Henry Lewis, J. B. Lippincott, H. Pratt McKean, I. V. Williamson. The Board reelected David J. Brown, Secretary; Samuel Bradford, Treasurer.

**Philadelphia, Wilmington & Baltimore.**—At the annual meeting in Wilmington, Del., Jan. 13, the following directors were chosen: Richard Olney, Enoch Pratt, Samuel M. Shoemaker, Thomas Whitridge, Baltimore; Jacob Tome, Port Deposit, Md.; Joseph Brinhurst, Samuel Harlan, Jr., Charles Warner, Wilmington; Samuel M. Felton, Thurlow, Pa.; Isaac Hinkley, Wm. Sellers, Philadelphia; Charles P. Bowditch, Wm. Minot, Robert H. Stevenson, Nathaniel Thayer, Boston. The only new director is Mr. Olney, who succeeds Thomas Kelso, deceased. The board reelected Isaac Hinkley President; Enoch Pratt, Vice-President; Alfred Horner, Secretary and Treasurer; Robert Craven, Assistant Treasurer.

**Pittsburgh, New Castle & Lake Erie.**—At the annual meeting in Pittsburgh, Jan. 13, Henry R. Low was chosen President, with the following directors: A. M. Marshall, Grinnell Burt, James S. Negley, Geo. A. Chalfant, J. C. Lewis, J. D. Lytle, C. S. Passavant, Charles Gibson.

**Pittsburgh Southern.**—At the annual meeting in Pittsburgh, Jan. 13, the following were chosen: President, George P. Hays; First Vice-President, Henry Warner; Second Vice-President, F. G. Kammerer; Third Vice-President, Joshua Wright; Secretary, M. K. Salsbury; Treasurer, T. Brent Swearingen; General Superintendent, A. C. Hays; General Freight and Passenger Agent, J. H. Miller; Directors, J. P. Miller, John W. Boyer, A. Murray, Joseph Kammerer, Wm. Espy, Josiah Reamer, Thos. McClelland, V. Harding, J. P. Donley, Joseph H. Phillips, West Fry, W. W. Thomson.

**Pittsburgh, Virginia & Charleston.**—At the annual meeting in Pittsburgh, Jan. 13, the following were chosen: President, John Scott, Pittsburgh; Vice-President, B. F. Jones, Pittsburgh; Directors, D. A. Stewart, Jos. Walton, H. B. Hays, M. B. Thompson, Pittsburgh; George V. Lawrence, Washington County, Pa.; Alexander Patton, Greene County, Pa.; J. N. Du Barry, Philadelphia; D. P. Corwin, Secretary and Treasurer; J. M. Byers, General Superintendent and Chief Engineer; John F. Scott, Assistant Superintendent; W. J. Rose, General Freight and Passenger Agent.

**Rutland & Whitehall.**—The following were chosen Jan. 1: W. W. Cook, President; I. V. Baker, Vice-President; Charles R. Allen, Clerk; Ira C. Allen, Treasurer and Transfer Agent; W. W. Cook, I. V. Baker, Ira C. Allen, Norman Peck, George H. Cramer, Directors. The road is leased to the Delaware & Hudson Canal Company.

**St. Louis, Vandalia & Terre Haute.**—At the annual meeting in Greenville, Ill., Jan. 14, the following directors were chosen: A. G. Henry, Charles S. Seydt, W. S. Smith, Greenville, Ill.; J. S. Peers, Collinsville, Ill.; Robert L. Dulany, Marshall, Ill.; W. R. McKeen, Terre Haute, Ind.; Thomas D. Messler, Wm. Thaw, Pittsburgh; Thomas A. Scott, Philadelphia. The board reelected Thomas D. Messler, President; W. H. Barnes, Treasurer; Williamson Plant, Secretary. The road is leased to the Terre Haute & Indianapolis.

**Salem & Lowell.**—At the annual meeting, Jan. 8, the following directors were chosen: Robert H. Butcher, Alden P. Buttrick, F. E. Clarke, H. G. Herrick, Addison Putnam, Daniel S. Richardson, George Rannels. The board elected Daniel S. Richardson, President; F. H. Nourse, Clerk and Treasurer. The road is leased to the Boston & Lowell.

**Springfield, Jackson & Pomeroy.**—The following officers have been elected for the ensuing year: President, George H. Froy, Springfield, O.; Vice-President, H. L. Chapman, Jackson, O.; Secretary, George R. Barnes, Springfield, O.

**Terre Haute & Indianapolis.**—At the annual meeting in Terre Haute, Ind., Jan. 6, the following directors were chosen: Wm. R. McKeen, D. W. Minshall, Alex. McGregor, Geo. E. Farrington, F. C. Crawford, Jos. Collett, Henry Ross. The board reelected W. R. McKeen, President; W. H. Buckingham, Secretary and Auditor; Richard Morris, Treasurer.

**Texas Western.**—At the annual meeting in Houston, Tex., Jan. 3, the following directors were chosen: A. M. Gentry, H. H. Dooley, E. Pilot, T. H. Scanlan, C. R. Gentry, J. T. Brady, W. B. Hotchkiss, C. Congreve, G. K. Otis.

## PERSONAL.

—Herr Richard Hartmann, of Chemnitz, Saxony, died recently, aged 89 years. He was one of the noted locomotive builders of Europe. Commencing life as a journeyman machinist, he started a shop for building cotton machinery in Chemnitz in 1847, and in 1857 added locomotives to his manufactures. The shop grew to a great size, and has lately built mining machinery also. In 1872 Herr Hartmann sold his works to the Saxon Machine Company, but retained a large share in the ownership and management until his death.

—Mr. Fred. Wild, General Freight and Ticket Agent of the Western Union Railroad, and his wife celebrated their silver wedding in Racine, Wis., Jan. 2. The occasion was a very pleasant one, and the interest was increased by the wedding of Mr. Wild's daughter, which took place at the same time.

—Mr. W. K. Morley, Superintendent of Telegraph of the Chicago & Alton, was married recently to Miss Fanny Ione Leehr, of Bloomington, Ill.

—Mr. J. B. Smith, at one time President of the old Milwaukee & Horicon Company, died in Milwaukee, Jan. 3, aged 67 years.

—A dispatch from Bloomington, Ill., announces the retirement of Mr. John A. Jackman, for 14 years past Superintendent of Machinery of the Chicago & Alton. The reasons are not given. Mr. Jackman was recently placed in charge of the Car Department in addition to his former duties.

—Mr. W. G. Brown, Assistant General Passenger Agent of the Denver & Rio Grande Railroad, has resigned his position to take the General Agency of the Central Colorado Improvement Company and the Southern Colorado Coal & Town Company. These two corporations control a large amount of property, and their business extends into nearly every town of any proportions in Colorado. The Improvement Company owns and operates the large Canon coal fields, and the railroad leading thereto. The Southern Colorado Company controls the town site of El Moro and the coal fields and coke ovens in that vicinity, as also the South Pueblo Town Company. Of these large properties and their transactions Mr. Brown will hereafter have the management.

—A dispatch from Boston, Jan. 14, says: "Benjamin F. Patrick, late General Ticket Agent of the Eastern Railroad Company, was arraigned in the Municipal Court to-day upon a charge of embezzling the funds of that corporation to the amount of \$1,800. A continuance was granted of one week from to-day, the defendant being ordered to recognize in \$3,000 for his appearance."

—Gen. W. J. Sewell, Superintendent of the West Jersey Railroad, has been chosen President of the New Jersey State Senate. This is Gen. Sewell's seventh year in the Senate, and the third time he has been chosen President.

—Mr. Wm. Mattoon, who died at Westfield, Mass., Jan. 12, aged 64 years, had been a noted railroad contractor. He began as a builder and built several large mills, and 35 years ago he constructed part of the Worcester & Nashua road. In 1850 he became a member of the firm of Phelps, Mattoon & Barnes, which built the Rome & Watertown, the Potsdam & Watertown, the Buffalo & Corning and the St. Louis, Alton & Terre Haute. Later, as one of the firm of Dawson, Mattoon & Messer, he built the towers for the Cincinnati Suspension bridge, besides much other work. For some years past he had done no work, being in poor health.

—Mr. Wm. Robinson has resigned his position as General Superintendent of the Buffalo, New York & Philadelphia road, which he has held nearly three years. He was previously Division Superintendent on the Lake Shore road. Mr. Robinson resigns on account of ill health, and will make a trip to the West.

—Hon. Gustav Schleicher, Representative from the San Antonio District in Texas, and Chairman of the House Committee on Railroads, died in Washington, Jan. 10, aged 55 years. He was born in Darmstadt, Germany, and was a civil engineer by profession, having been engaged in the construction of several German roads. He settled in Texas in 1847, and was first elected to Congress in 1874. As a member he stood well and was much respected.

—Mr. J. D. Burr, now First Assistant Engineer of the Atchison, Topeka & Santa Fe, was, on Christmas Day, presented with a valuable gold watch and chain by the men of the Bridge and Building Department, of which he was formerly Superintendent. Mr. Burr is now stationed at Trinidad, Col.

—The Engineer Corps of the Madeira & Mamore Railroad met at San Antonio, Brazil, Nov. 19, and passed appropriate resolutions, expressing their regret at the death of Rodman McIlvaine, one of their associates, which occurred a few days previously.

—Mr. William Baker, for many years Engineer-in-Chief of the London & Northwestern Railway, and actively employed in the construction of English railroads after 1844, died Dec. 30, in his 62d year.

—Hon. Willard Carpenter, a prominent citizen and merchant of Evansville, Ind., has failed, with heavy liabilities. His troubles are caused chiefly by his connection with the proposed air-line road from Evansville to Indianapolis, of which he was the chief projector.

## TRAFFIC AND EARNINGS.

## Grain Movement.

Receipts and shipments of grain of all kinds for the week ending Jan. 4 have been, in bushels, for the past seven years:

Year.	Northwestern Receipts.	Shipments.	Atlantic Receipts.
1873.....	1,768,807	407,730	.....
1874.....	2,278,738	1,123,078	1,357,133
1875.....	2,102,531	608,091	1,543,855
1876.....	1,712,002	1,059,356	1,928,553
1877.....	2,185,445	938,344	1,412,388
1878.....	1,452,608	1,012,056	2,764,884
1879.....	3,155,513	1,183,148	2,147,844

Compared with the previous year, the receipts at Northwestern markets this year have been more than twice as great, the shipments from those markets 17 per cent. greater, and the receipts at Atlantic ports 22½ per cent. less. Bottomless mud last year hindered Northwestern receipts; snow blocking the railroads this year has greatly decreased Atlantic receipts.

Of the Atlantic receipts this year, 80.1 per cent. was at Baltimore, 23.3 at New York, 27.3 at Philadelphia, 7.1 at Boston, 6 at New Orleans, and 1.2 at Portland. New York's receipts were made exceptionally small by the snow blockades, which affected chiefly the roads carrying to it.

For the week ending Jan. 14, the receipts and shipments at Chicago and Milwaukee were:

	1879.	1878.
Chicago—		
Receipts.....	1,428,451	810,600
Shipments.....	770,112	716,500
Milwaukee—		
Receipts.....	455,500	349,000
Shipments.....	154,200	357,000

## And receipts at four Atlantic ports were:

	1879.	1878.
New York.....	789,461	1,034,840
Philadelphia.....	504,000	445,500
Baltimore.....	545,300	423,550
Boston.....	103,255	137,280

Northwestern receipts last year were greatly limited by the bad condition of the country roads. New York receipts this year have been still more limited by the snow blockade on the New York Central and Erie railroads.

## Railroad Earnings.

Earnings for various periods are reported as follows:

Year ending Sept. 30:	1877-78.	1876-77.	Inc. or Dec.	P. c.
Charlotte, Columbia & Augusta.....	\$441,357	\$497,157	D.	\$55,800 11.2
Expenses.....	272,729	294,968	D.	\$21,869 7.4
Net earnings.....	\$168,578	\$202,489	D.	\$33,911 16.7
Earnings per mile.....	2,523	2,550	D.	287 11.2
Per cent. of exps.....	61.80	59.27	L.	2.53 4.3
Year ending Oct. 31:				
Delaware.....	\$365,580	\$419,806	D.	\$54,226 13.0
Expenses.....	255,906	293,804	D.	\$37,958 13.0
Net earnings.....	\$109,674	\$125,942	D.	\$16,268 13.0
Earnings per mile.....	4,276	4,910	D.	634 13.0
Per cent. of exps.....	70.00	70.00	.....	.....
North Pennsylvania.....	1,400,924	1,482,705	D.	\$81,781 1.5
Expenses.....	887,862	920,658	D.	\$32,796 3.6
Net earnings.....	\$573,062	\$562,047	L.	\$11,015 2.0
Earnings per mile.....	13,527	13,729	D.	202 1.5
Per cent. of exps.....	60.77	62.08	D.	1.31 2.1
Year ending Dec. 31:	1878.	1877.		
Atchison, Topeka & Santa Fe.....	\$3,930,847	\$2,679,105	L.	\$1,251,742 46.7
Bur., Cedar Rapids & No.....	1,527,067	1,249,881	L.	\$277,786 22.2
Chicago & North-western.....	14,528,653	12,793,602	L.	\$1,735,051 13.6
Great Western.....	4,447,073	4,534,676	D.	\$87,603 1.9
Ind., Bloom. & West-ern.....	1,260,947	1,200,663	L.	\$60,284 4.2
Kansas Pacific.....	3,729,606	3,294,549	L.	\$435,057 13.2
Mo., Kan. & Texas.....	2,981,679	3,174,320	D.	\$192,641 6.1
St. L., Alton & T. H., Belleville Line.....	502,807	517,978	D.	\$15,171 2.9
St. Louis, Iron Mt. & Southern.....	4,518,236	4,500,422	L.	\$17,814 0.4
St. Louis, Kan. City & No.....	3,317,816	3,150,477	L.	\$167,339 5.3
St. Louis & South-eastern.....	1,187,011	1,098,494	L.	\$88,517 8.1
Southern Minnesota.....	642,963	689,085	D.	\$46,122 6.7
Toledo, Peoria & War-saw.....	1,243,959	1,106,067	L.	\$137,292 12.4
Union Pacific.....	12,725,879	12,493,834	L.	\$232,045 1.9
Wabash.....	5,024,105	4,585,913	L.	\$438,192 9.6
Eleven months ending Nov. 30:				
At., Miss. & Ohio.....	\$1,575,216	\$1,613,930	D.	\$38,714 2.4
Net earnings.....	481,011	434,945	D.	\$46,066 10.6
Bur., Cedar Rap. & No.....	1,402,091	1,120,327	L.	\$281,964 25.2
Net earnings.....	404,088	367,377	L.	\$36,711 10.0
Chicago & Alton.....	4,330,572	4,147,544	L.	\$183,028 4.4
Net earnings.....	1,895,530	1,850,757	L.	\$44,773 2.1
Dakota Southern.....	200,234	191,357	L.	\$8,877 4.6
Net earnings.....	95,791	.....	.....	.....
Denver & Rio Gr'de.....	1,033,490	700,239	L.	\$333,251 47.6
Net earnings.....	454,859	339,708	L.	\$115,151 28.0
Ind. & Gr. Northern.....	1,403,968	1,361,300	L.	\$42,668 3.1
Net earnings.....	545,131	383,183	L.	\$161,948 42.3
Kansas Pacific.....	3,469,156	3,036,442	L.	\$432,714 14.3
Net earnings.....	1,441,386	1,298,700	L.	\$142,686 11.0
Nash., Chatta. & St. Louis.....	1,482,129	1,586,145	D.	\$104,016 6.6
Net earnings.....	511,344	635,701	D.	\$124,357 19.6
St. Louis, Iron Mt. & Southern.....	4,046,126	3,974,118	L.	\$72,008 1.8
Net earnings.....	1,719,486	1,864,322	D.	\$144,836 7.8
St. Paul & Sioux City.....	554,615	498,357	L.	\$56,258 11.3
Net earnings.....	207,911	183,085	L.	\$24,826 13.6
St. Paul City & St. Paul.....	351,066	309,141	L.	\$41,925 13.8
Net earnings.....	105,227	97,307	L.	\$7,920 8.1
Southern Minnesota.....	587,341	622,108	D.	\$34,767 5.6
Net earnings.....	285,752	265,462	L.	\$20,290 7.6
Union Pacific.....	11,871,724	11,698,751	L.	\$172,973 1.5
Net earnings.....	7,133,534	6,740,404	L.	\$393,130 5.8
Month of December:				
Atchison, Topeka & Santa Fe.....	\$323,500	\$246,778	L.	\$76,722 31.1
Bur., Cedar Rapids & Northern.....	124,676	129,554	D.	\$4,878 3.8
Chicago & North-western.....	1,114,500	1,006,930	L.	\$107,570 10.7
Ind., Bloom. & West-ern.....	90,111	93,117	L.	\$3,006 6.4
Kansas Pacific.....	280,450	258,107	L.	\$22,343 9.9
Mo., Kansas & Texas.....	242,568	256,021	D.	\$13,453 5.3
St. L., Alton & T. H., Belleville Line.....	48,763	41,420	L.	\$7,343 17.7
St. Louis, Iron Mt. & Southern.....	472,110	526,304	D.	\$54,194 10.3
St. Louis, Kan. City & No.....	279,905	258,685	L.	\$21,220 8.2
St. Louis & South-eastern.....	100,932	91,303	L.	\$9,629 9.6
Southern Minnesota.....	55,922	66,976	D.	\$11,354 16.9
Toledo, Peoria & War-saw.....	88,044	90,687	D.	\$2,643 2.9
Union Pacific.....	854,155	795,083	L.	\$59,072 7.4
Wabash.....	360,547	375,897	D.	\$15,350 4.1

## First week in January:

	1879.	1878.		
Chicago & Eastern Illinois.....	\$13,791	\$13,165	L.	\$626 4.7
St. Louis, Iron Mt. & Southern.....	70,200	81,626	D.	\$11,426 14.0
Week ending Jan. 3:				
Great Western.....	\$70,140	\$69,088	D.	\$10,939 29.2
Week ending Jan. 4:				
Grand Trunk.....	\$141,907	\$150,191	D.	\$8,284 5.5

## Petroleum Exports.

Exports from the United States during the past four years have been as follows, from the several ports, in gallons:

	1878.	1877.	1876.	1875.
New York.....	216,565,281	250,707,538	145,237,750	148,361,888
Philadelphia.....	73,941,581	47,783,903	67,020,806	63,783,615
Baltimore.....	38,739,936	45,323,727	40,599,744	25,364,833
Boston.....	3,694,084	4,351,428	3,174,800	2,534,081
Richmond.....	898,000	4,882,314	.....	.....
Portland.....	497,270	1,407,984	.....	.....
Norfolk.....	391,100	.....	.....	.....

Total.....334,006,152 354,847,994 256,033,190 240,074,437

Equal to tons, 1,113,354 1,182,827 853,442 800,248

The percentages of the several ports have been:

	1878.	1877.	1876.	1875.
New York.....	64.8	70.6	56.7	61.8
Philadelphia.....	22.0	13.5	26.2	26.6
Baltimore.....	11.6	12.8	15.9	10.6
Boston.....	1.1	1.2	1.2	1.0
Richmond.....	0.3	1.4	.....	.....
Portland.....	0.2	0.4	.....	.....
Norfolk.....	0.1	.....	.....	.....



in 1877, but 30½ per cent. greater than in 1876, or any previous year.

#### Cotton.

Receipts for the week ending Jan. 10 and for the crop year from September to Jan. 10, and reported as follows by the *Commercial and Financial Chronicle*:

	1879.	1878.	1877.	1876.	1875.
Week.....	121,091	142,090	101,132	161,515	95,242
Crop year.....	2,840,382	2,640,769	2,778,363	2,640,375	2,310,029

Exports for two years have been:

	1878.	1877.
Week.....	105,288	126,317
Crop year.....	1,552,157	1,365,817

For the crop-year down to Jan. 3, 22.2 per cent. of the receipts were at New Orleans, 18.8 at Savannah, 14.1 at Galveston, 14.1 at Charleston, 12.7 at Norfolk, and 7.9 at Mobile.

#### Pittsburgh Coal Shipments by the Ohio River.

Shipments of coal from Pittsburgh down the Ohio River for ten years have been, in tons of 2,240 lbs.:

Year.	Tons.	Year.	Tons.
1869.....	1,632,375	1874.....	2,213,438
1870.....	1,544,063	1875.....	2,325,938
1871.....	1,665,150	1876.....	2,087,925
1872.....	1,990,987	1877.....	2,510,118
1873.....	2,194,443	1878.....	2,441,138

Of the shipments in 1878, 944,100 tons were to Cincinnati, 1,457,550 tons to Louisville, and 37,612 tons to St. Louis.

#### Lake Superior Iron Ore.

The shipments of Lake Superior iron ore from the mines for six years have been:

Year.	Tons.	Year.	Tons.
1873.....	1,237,886	1876.....	1,039,144
1874.....	1,021,982	1877.....	1,018,520
1875.....	992,593	1878.....	1,124,981

The shipments this year thus far have been 106,461 tons, or 10.4 per cent. greater than in 1878, and more than in any other year except 1873.

#### Petroleum.

The Standard Oil Company, which controls about nineteen twentieths of the refining capacity of Pittsburgh, reports its receipts of crude and shipments of refined at that place in 1878 as follows:

	Gallons.	Barrels.	P. c. of total.
Receipts of crude.....	89,021,528	2,133,846	100.0
Shipments—			
To Philadelphia.....	34,546,925	822,546	49.0
To Baltimore.....	23,592,050	561,001	32.4
To New York.....	8,613,500	205,083	12.2
Local.....	3,800,000	90,476	5.4
Total.....	70,522,475	1,679,106	100.0

#### Southwestern Association Rates.

The Southwestern Railway Association issues a circular, dated Jan. 1, in which are the rates to be charged on west-bound freight from points east of the roads in the Association. These rates are different on shipments from different places. Thus from Chicago to Missouri River points (Kansas City, Leavenworth, Atchison and St. Joseph), the rates in cents per 100 lbs. are on freights:

	1.	2.	Class.	4.	Special.
From Cleveland.....	85	70	45	30	25
From Buffalo.....	85	65	45	30	25
From Pittsburgh or Wheeling.....	84	68	45	30	25

And from St. Louis to Missouri River points the rates are:

	1.	2.	Class.	4.	Special.
From Cleveland.....	65	50	30	20	15
From Buffalo.....	65	50	35	20	15
From Cincinnati.....	65	50	35	20	15
From Pittsburgh or Wheeling.....	65	50	29	18	15

Rates to Missouri River points are the same as from St. Louis on shipments from Cleveland, from Hannibal, West Quincy and Burlington on shipments from Buffalo, and from Louisiana, Hannibal and West Quincy on shipments from Pittsburgh and Wheeling.

Rates on shipments from Cincinnati are, to Missouri River points:

	1.	2.	Class.	4.	Special.
From Louisiana or Hannibal.....	60	45	30	20	15
From Quincy, Burlington or Davenport.....	65	50	35	20	15

And rates on shipments from Pittsburgh and Wheeling are:

	1.	2.	Class.	4.	Special.
From Burlington.....	65	50	30	15	15
From Davenport.....	65	50	30	15	12½

These rates, when less than the local rates of the Association, apply only to through business above specified and carried by all-rail routes through to destination.

Rates on lumber to Missouri River points, beginning Jan. 1, are, for car-loads of at least 24,000 lbs., 30 cents per 100 lbs. from Toledo, 25 cents from Chicago, and 15 cents from St. Louis.

#### Immigration at New York.

The Bureau of Statistics reports that 81,505 immigrants arrived in New York in 1878, against 66,282 in 1877, the increase being 23 per cent. The total arrivals of passengers from abroad at the port were 121,695 in 1878 against 96,530 in 1877. Most of those not immigrants were citizens of the United States returning from a visit to Europe.

#### Coal Movement.

Coal tonnage over the Sharpville Railroad in Mercer County, Pa., for the year was: 1878, 192,766; 1877, 239,031; decrease, 46,265 tons, or 19.4 per cent. Total production for 14 years of the mines on the line of the road has been 3,329,823 tons, distributed as follows: Erie and points north by rail, 1,808,758; Erie by canal, 191,608; Sharpville for furnaces, etc., 719,273; other points in Shenango Valley, 477,000; sold at mines, 133,184; total, 3,329,823 tons. The decrease last year was chiefly in shipments to Erie.

#### Minneapolis Wheat Receipts.

The Millers' Association of Minneapolis during the year ending Dec. 31, 1878, purchased outside of the city, to come in by rail, 4,756,870 bushels of wheat. During the same period they purchased from teams at the mills 421,190 bushels, or a total of 5,178,060 bushels bought to supply the Minneapolis flouring-mills during the year. This does not include a large amount of wheat purchased by individual millers outside of the territory occupied by the association. There are several hundred thousand bushels of this wheat now in country elevators, owing to lack of storage in the city.—*St. Paul (Minn.) Pioneer-Press*.

#### THE SCRAP HEAP.

##### Railroad Equipment Notes.

The Pullman Palace Car Co.'s shops at Detroit are to build four hunting-cars for the use of parties going hunting on the Plains. Besides sleeping accommodations they will have a kitchen and a room for dogs, guns and hunting equipments.

The Economy Car Works, at Cannelton, Pa., have completed 90 flat cars for the Pittsburgh & Lake Erie road.

The New York Supreme Court has refused to grant the injunction asked for by Wm. O. Cooke, a stockholder of the La Mothe Manufacturing Co. of New York, who sought to enjoin the National Tube Works Co. from building iron cars, acting under a ten years' exclusive license from the La Mothe Co.

The Pennsylvania Railroad shops at Altoona are building 10 freight engines for the Pittsburgh, Cincinnati & St. Louis road.

#### Iron and Manufacturing Notes.

The *Bulletin* of the American Iron & Steel Association makes the following statement of the condition of the blast-furnaces of the United States:

	1878.	1877.	Inc. or Dec.	P. c.
In blast, Dec. 31.....	260	270	D. 10	3.7
Out of blast Dec. 31.....	440	446	D. 6	61.3
Total.....	700	716	D. 16	2.2

Production of pig-iron for year..... 2,382,000 2,315,585 I. 66,415 2.9

Stock on hand, Dec. 31..... 516,000 642,351 D. 126,351 19.7

Production and stock on hand are in net tons; both are partly estimated for 1878. There appears to be a decrease of 16 in the total number of blast-furnaces. The iron produced in 1878 is classified as follows: Anthracite, 1,039,000; bituminous, 1,093,000; charcoal, 250,000; total, 2,382,000 tons.

During 1878 the New Albany (Ind.) Rolling Mill made 10,095 tons of iron rails.

The works of the Franconia Iron & Steel Co., at Wareham, Mass., were recently started up.

The Beaver Falls (Pa.) Steel Works are full of orders and will soon begin to run double turn.

The Galena Oil Works, Limited, at Franklin, Pa., have been reorganized. Mr. Charles Miller has been chosen President and General Manager, all of the other members of the firm retiring and their places being filled by parties largely interested in the oil trade. The name of the concern remains unchanged.

Ferrol Furnace, in Augusta County, Va., has been put in blast by an Ohio party.

Loomer Furnace, in Augusta County, Va., has its new stack nearly finished. It will be put in blast as soon as ready.

#### Bridge Notes.

Kellogg & Maurice, at Athens, Pa., are building an iron viaduct 200 ft. long and 40 ft. high for the Southern Central road; three spans of 150 ft. each for the Union Pacific; five spans, 395 ft. in all, for the Erie, and several other bridges.

The Keystone Bridge Co., of Pittsburgh, has just finished a new double-track bridge 210 ft. long over the Mahoning River at Warren, O., for the Atlantic & Great Western road. It replaces one carried away by a freshet.

It is reported that contracts for a number of bridges for the Costa Rica Railroad are shortly to be let in this country.

#### Spikes.

The lightning-rod man applied to the president of a railroad to put lightning-rods on all his cars. "Lightning-rods on our cars?" asked the latter. "Why, certainly." "What in the world do we want them for?" "Because they make good conductors," replied the man, as he closed the door hastily behind him.

Erie train No. 12 that passed east Tuesday morning, shortly after 12 o'clock, had on board three millions of dollars in silver coin, being taken to New York by the Express Company. It was in ironed wooden boxes, occupying three cars and guarded by five men. A great many people who have never seen so much money went and looked Tuesday at the road-bed over which the wealth had passed.—*Elmira Advertiser*.

Tall stories about the snow are now in order. Some men on a stalled freight train on the Buffalo, New York & Philadelphia road started out to find a freight train supposed to be a few miles ahead. By following the tops of the telegraph poles they kept to the road, but saw no freight train. At last they reached a station and found that they had walked right over the top of that freight without knowing it. When the shovellers came along they went down five feet before they struck the smoke-stack of the engine. Such is the story.

For the first time within the knowledge of man a railroad train has been lost. Nobody knows where the Burlington train is, except that it is somewhere between the termini. It left there Tuesday, and has not been heard from since.—*Ottawa (Kan.) Republican*, Jan. 9.

#### Prices of Rails.

Quotations for steel rails continue at \$42 to \$44 per ton at mills. An order for 10,000 tons for the Northern Pacific has recently been placed, and many small orders have been given; some large orders are said to be held back in hopes of lower prices.

For iron rails prices are \$32.50 to \$35 per ton at mills, with a considerable demand. The mills are inclined to insist upon cash or first-class security, which buyers are not always ready to give.

Old rails are in demand with light supply. Prices have been \$20 to \$20.50 at Philadelphia; \$22.50 to \$23.50 on cars at Pittsburgh and \$18.75 f. o. b. at New York.

#### Steel Fire-Boxes for Locomotives.

Mr. R. O. Carscadin, Master-Mechanic of the Southwestern Division, Chicago, Rock Island & Pacific, writes as follows: "Out of twenty engines built by the Grant Locomotive Works in 1871, that I have charge of on this division, with all steel boilers and fire-boxes, I have never found a crack in the fire-box on a single one. The engines have been doing extremely hard service, and have frequently had to run through water that has put the fire out entirely. I think I can recommend steel for locomotive boilers."

#### Steamship Voyages on the Pacific.

Passenger agents who are ticketing passengers to Hong Kong, Calcutta or around the world, ought to be able to tell their customers how long they will be on the Pacific, which they may learn from the following, which is from the *San Francisco Post*, Jan. 2:

"The grand average last year of the passages of China steamers of the Pacific Mail Steamship Company to and from this port was 30 days, 16 hours for Hong Kong; 20 days, 17 hours, 48 minutes for Yokohama. The best average was made by the City of Peking, which did a trip from Hong Kong in 26 days, and from Yokohama in 16 days, 13 hours. The grand average of the Oriental & Occidental Company's steamers was 27 days, 12 hours from Hong Kong, and 17 days, 10 hours and 56 minutes from Yokohama. The best average was made by the Oceanic, which did one trip from Hong Kong in 24 days, and from Yokohama in 15 days, 21 hours and 20 minutes. On the Australian Line the grand average from Sydney was 26 days, 16 hours and 55 minutes; from Honolulu, 7 days, 15 hours and 24 minutes. The best average was made by the Australia, which recorded 26 days, 14 hours and 20 minutes from Sydney; 7 days, 15 hours and 15 minutes from Honolulu.

lulu. To and from Panama the best trip was made, by the steamer Granada, in 13 days, 1 hour. The grand average stood 19 days, 14 hours and 51 minutes."

#### Continuous Brakes in the United Kingdom.

A correspondent of the *English Mechanic* writes to that paper as follows: "The Board of Trade has lately issued the first 'Return' which has been made by the railway companies of the United Kingdom, in pursuance of the Railway Returns Continuous Brakes Act, 1878. The 'Return' shows the amount of rolling stock used on passenger trains up to the 30th of June, 1878, giving in detail the amount fitted with continuous brakes, the amount fitted in the last half-year, and the amount not fitted. The railway companies are also required to state if the brakes they use fulfill the conditions laid down in the Board of Trade circular dated Aug. 30, 1877. The return states that the three brakes—the Sanders automatic vacuum, Steel-McInnes, and the Westinghouse automatic—appear to comply with the conditions specified in their circular, and that the whole of the other brakes 'comply only in part with the conditions,' pointing out wherein each brake fails."

The correspondent then gives a table showing the number of engines and coaches which are fitted with the different kinds of continuous brakes, and also the number that are not fitted. This table is condensed below:

Statement Showing the Amount of Rolling Stock fitted with Continuous Brakes in the United Kingdom to June 30, 1878.

	Engines.	Coaches.
Sanders' automatic vacuum brake.....	25	82
Steel-McInnes.....	2	13
Westinghouse automatic.....	145	722
Barker's Hydraulic.....	2	87
Clark's chain.....	3	69
Clark & Webb's chain.....		2,051
Clark's (old) and Wilkin & Clark's chain.....		241
Fay's self-acting.....		10
Fay's Manual.....		1,330
Fay & Newall.....		7
Heberlein Automatic friction.....		5
Newall.....		639
Smith's vacuum.....		426
From hand.....		20
Westinghouse pressure.....		132
Total fitted with continuous brakes.....	634	7,310
Total not fitted with continuous brakes.....	4,290	31,885
Percentage of stock fitted with continuous brakes.....	13	19

#### Good Only One Way.

An Eastern paper tells this story: "Years ago the Boston & Albany Railroad made a rule that passengers should not ride on tickets intended to be used in the opposite direction from that in which they were journeying. One day the conductor came to a well-dressed, middle-aged lady, just after leaving Worcester on the Western-bound express, who handed him a ticket from Palmer to Worcester. He protested that, although very sorry, the rules of the company wouldn't allow him to take that ticket for a moment. The lady said that she had bought it in good faith, but had never before had an opportunity to use it, and intimated, with studied politeness, that all such regulations were senseless. And finally she remarked: 'I am willing to ride backward all the way, if that will be any comfort to you.' He took the ticket."

#### Pass, if You Please.

One of the fire-ejected managers remarked yesterday that even the paper left on his desk was not scorched or soaked. And the consequent disappointment was great, as a large envelope filled with applications for passes was thereby saved.—*Chicago Inter-Ocean*.

Dean Richmond once asked an applicant for a dead-head pass what were the grounds of his request: "Why," said the dead-head, "simply this:—I don't want to pay for traveling if I can help it." The crusty old railroad king took the fellow to his heart, gave him a pass, and said in an ecstasy: "Sir, I admire you. You are the first dead-head that ever told the truth."—*The Season*.

A New England Superintendent received an application for an annual pass, on the ground that the applicant's grandfather drove a stage on the line of his road, and the building of the road broke up his business. It was not granted.

#### Tramps.

The festive tramp has been pretty quiet lately, but he still survives and breaks out occasionally, as shown by the following, from the *San Francisco Post*: "A gang of tramps attempted to capture a freight train near Stockton on the 6th. Four shots were fired at them by the conductor. The sheriff arrested five of the tramps. Six new revolvers were found on one of them."

#### A Sand Blockade.

While our Northern roads were fighting snow-drifts, the Southern Pacific, away down on the Colorado Desert, where snow was never heard of (and rain scarcely ever), was blocked by drifts of another kind. The Los Angeles (Cal.) *Herald* of recent date thus describes the trouble: "Day before yesterday afternoon the out-going Yuma train left Los Angeles on time. Everything went on as usual until it approached Cucamonga station. At this point a sand-storm of extraordinary violence was encountered. The train was soon obliged to stop. Superintendent Hewitt was at once communicated with by telegraph, and a number of men were dispatched from all quarters to clear the track, but utterly without avail. The train was delayed some 15 hours. When we state that the rails for a distance of three or four miles were covered with sand to depths ranging from one to three feet, the force of the wind may be conjectured. The simoom or sirocco, or whatever it may be called, came whistling through the Cajon pass as though it were discharged from a funnel. The incoming Yuma train was delayed for an hour and a half through the storm. Some seven years ago a whirlwind poured out of the Cajon pass, which took substantially the same course as the wind day before yesterday. The line of plain traversed by it was about three miles wide, but it fortunately stopped right at the edge of the celebrated Cucamonga vineyard. For much of this



width the soil was shaved off as with a knife, being carried resistlessly over the Cucamonga plains. Sand was piled to a height of several feet over the roof of the station of the old stage company, making a total sand-drift of over 20 feet high. The storm of the other day must have been a twin brother of that."

#### Iron Prices in 1878.

The Bulletin of the American Iron and Steel Association reports as follows the course of prices of leading staples of iron manufactured in 1878:

MONTHS.	No. 1 anthracite foundry pig-iron in Philadelphia.	Iron rails at works in Pa.	Bessemer steel rails at works in Pa.	Best refined bar-iron in Philadelphia.
January..	\$18.50	\$32.50	\$41.00	\$44.80
February..	18.50	32.50	41.50	44.80
March....	18.50	32.50	41.50	44.80
April.....	18.50	32.50	42.00	44.80
May.....	18.00	32.50	43.50	44.80
June.....	17.25	32.50	43.00	44.80
July.....	17.25	33.00	43.50	44.80
August....	17.50	33.00	42.50	44.80
September..	17.50	33.00	42.50	44.80
October...	17.00	33.00	42.50	42.50
November..	16.50	33.00	42.00	42.50
December..	17.00	33.00	41.00	42.50
Average.	\$17.07	\$32.75	\$42.20	\$44.24

"The decline in the price of pig-iron during the year was \$1.50 a ton, and on bar-iron it was one-tenth of a cent. per pound, or \$2.24 a ton. Iron and steel rails sold during the year at average prices which were higher than quotations in January."

#### OLD AND NEW ROADS.

**Allegheny Valley.**—Suit has been begun against this company by Ashbel H. Barney and others to recover a number of claims on account of the Buffalo, Corry & Pittsburgh road. On most of the claims judgments have already been obtained in New York, and it is now sought to enforce them in Pennsylvania.

**Atchison & Nebraska.**—The round-house and machine shop of this road, in Atchison, Kan., were destroyed by fire on the morning of Jan. 15. Four locomotives and all the machinery in the shops were destroyed or badly damaged. It is thought that the fire was started by tramps. The dispatches estimate the loss at \$100,000, which is probably too high.

**Baltimore & Ohio.**—This company has been preparing a new local freight tariff, which is to go into effect shortly. It is said to be satisfactory to the local shippers on the line. Vice-President Keyser recently submitted an explanation of this new tariff and of the general policy of the company to the committee appointed by the West Virginia Legislature to investigate charges of discrimination made against the company.

**Chesapeake & Ohio.**—The Governor of West Virginia, in his annual message, calls the attention of the Legislature to the question of taxation of the property of this company. He contends that the former exemption has been ended by the sale of the road and its transfer to a new company, and that an act of the Legislature, which is relied upon to continue the exemption, is in violation of the provisions of the state constitution.

**Chicago, Clinton, Dubuque & Minnesota.**—At a meeting of the board, held Jan. 7, it was resolved to offer to stockholders of record Jan. 15, an issue of \$400,000 five-year 7 per cent. bonds, to be dated Feb. 1, at par and accrued interest. The proceeds of said bonds are to be used to meet expenditures incurred in the purchase and building of extensions. Stockholders are to have the option of taking their proportion of bonds until Jan. 25, inclusive. The company has now no bonded debt, the old bonds having been all converted into stock.

**Chicago & Northwestern.**—This company is trying the plan of sending by telegraph to each station on its lines, daily weather reports, so that in the event of approaching storms or excessively cold weather the company may be enabled to guard against possible loss to perishable freight while in transit. This plan is expected to be of much value to shippers, and of use to trainmen also.

**Cincinnati, Hamilton & Dayton.**—A meeting of Cincinnati, Hamilton & Indianapolis bondholders was held in Cincinnati, Jan. 10, to consider some settlement as to those bonds. A statement was submitted showing that the Indianapolis road earned, at the best time, less than half the interest on \$2,500,000 bonds, and that it was not possible to continue paying the present interest. After much discussion it was decided to appoint a committee of five to endeavor to come to some agreement with the company, on a basis of a reduction of interest to 5 per cent., the \$700,000 bonds held by the Cincinnati, Hamilton & Dayton to be cancelled.

**Cumberland & Ohio, Northern Division.**—An agreement has been made, under which the Louisville, Cincinnati & Lexington Company is to complete the section of this road from Eminence, Ky., to Bloomfield, about 38 miles, for \$350,000 in bonds, and to lease the road when done. The net earnings are to be applied to payment of the interest and sinking fund on the bonds, and if there should be any surplus, the lessee is to retain one-tenth and pay over the rest to this company. If there should be a deficiency, the lessee will make it up, the amount required being considered as an advance to be charged against the leased road. The agreement will shortly be submitted to the stockholders for ratification.

**Delphos, Bluffton & Frankfort.**—This narrow-gauge road has been for some months in operation between Bluffton and Warren, Ind., 15 miles. The grading is all completed and bridges built between Bluffton and Decatur, 15 miles, and track-laying will begin as soon as the weather is favorable. The nine miles between Decatur and Willshire, on the Ohio line, have been located, and grading will begin as soon as the frost is out of the ground in the Spring. It is also expected to complete a good portion of the line between Warren and Kokomo next season. The road is to connect at Willshire with the Delphos & Kokomo. The surveys and location have been made by Chief Engineer W. J. Sherman; Hugh McKee is contractor for the work.

**Delphos & Kokomo.**—This narrow-gauge road is reported finished from Delphos, O., southwest 26 miles to Willshire on the Indiana line. From that point it is to be extended to Kokomo and Frankfort, Ind., by the Delphos, Bluffton & Frankfort, a section of which is completed, with work in progress on the rest. The stations on this road, with the distances from Delphos, are: Landeck, 4 miles; Venedocia, 8; Buena Vista, 14; Willshire, 20. The road was to be opened for business Jan. 15.

**Denver & Rio Grande.**—The report of Treasurer

Weitbrech gives the following figures for November and the eleven months ending Nov. 30:

	November.	Eleven months.
Freight.....	\$83,276.62	\$704,923.48
Passengers, mails and express.....	31,390.40	326,170.40
Miscellaneous.....	137.00	2,395.42
Total.....	\$114,804.02	\$1,033,489.30
Expenses.....	62,627.92	598,630.52
Net earnings.....	\$52,176.10	\$434,858.78
Per cent. of expenses.....	53.16	57.92

October earnings include \$2,037.73 for mails and other government business; expenses include \$10,000 for steel rails and \$5,000 for damages caused by fire. The month shows increase over November, 1877, of 47 per cent. in gross and 41 per cent. in net earnings.

**Denver, South Park & Pacific.**—Denver papers confirm the statement that this company has passed under the control of parties representing the Atchison, Topeka & Santa Fe Company. The conditions are said to be the purchase of \$700,000 bonds of the Denver, South Park & Pacific, the money to be used in extending the road from its present terminus at Slaght's, Col., to Leadville, 85 miles; 35 miles of this extension, from Trout Creek to Leadville, to be held and used in common with the Atchison, Topeka & Santa Fe's branch from Pueblo to Leadville.

**Flint & Pere Marquette.**—The following statement is made of the gross earnings for the year ending Dec. 31:

	1878.	1877.	Increase.	P. c.
Passengers.....	\$430,388	\$386,003	\$44,385	11.5
Freight.....	592,873	552,838	40,035	7.2
Mail and Express.....	32,756	31,855	901	2.8
Total.....	\$1,056,017	\$970,696	\$85,321	8.8
Total per mile.....	3,718	3,418	300	8.8

The sales of the Land Department during the year were 9,924 acres for \$135,805, against 8,508 acres for \$95,985 the previous year.

**Honda & Magdalena.**—Buttrick & Co., of Worcester, Mass., have taken a contract to survey and build a narrow-gauge railroad in the United States of Colombia, South America. It is to be 33 miles long, from the town of Honda to La Dorada, the head of navigation on the Magdalena River.

**Iron.**—This road, which runs from Ironton, O., to Centre Station, 13 miles, reports its tonnage for 1878 as follows: Pig iron, 9,292 tons; iron ore, 37,901; coal, 39,566; sundries, 6,414; total, 93,193; total, 1877, 122,518; decrease, 29,345 tons, or 24 per cent. The decrease was due to the stoppage of several furnaces on the line.

**Jerusalem & Jaffa.**—It is said that Mr. Thomas D. Lovett, formerly Consulting Engineer of the Cincinnati Southern, has taken a contract for a French company to build a railroad in Palestine from Jerusalem to the port of Jaffa on the Mediterranean. The distance is about 40 miles.

**Longview & Sabine Valley.**—Officers of this Texas road inform us that it is now doing a paying business, and that there is every prospect of an extension of at least 10 miles next summer.

**Metropolitan Elevated.**—This company's first-mortgage bonds have been put on the regular list at the New York Stock Exchange. The following statement is submitted by the company:

Assets:	
Construction, equipment and real estate.....	\$10,000,000
Patents, etc.....	655,000
Cash with N. Y. Loan & Improvement Co.....	321,250
Cash, supplies, agents' balances.....	42,000
Operating accounts.....	274,857
Total.....	\$11,293,815
Liabilities:	
Stock, held by N. Y. Loan & Improvement Co.....	\$3,155,000
First-mortgage bonds, held by N. Y. Loan & Improvement Co.....	3,000,000
Second-mortgage bonds, held by N. Y. Loan & Improvement Co.....	4,500,000
Traffic accounts.....	638,815
Total.....	\$11,293,815

The earnings from June 5 to Jan. 1 were as follows:

Earnings (\$98,271 per mile).....	\$638,750
Expenses (45.35 per cent.).....	289,670
Net earnings (\$53,706 per mile).....	\$349,080

The total length of road projected is 20 miles; in operation, 6½ miles double track. The authorized issue of first-mortgage bonds is \$600,000 per mile; amount actually issued, \$3,000,000. The first-mortgage bond bears 6, and the second mortgage, 7 per cent. interest.

Mr. Richard P. Morgan, Jr., a well-known engineer of Bloomington, Ill., has begun suit against the company to recover damages for infringement on a patent granted to him some years ago for an elevated railroad structure.

**New York & Brighton Beach.**—This company is making arrangements to build a railroad from Brighton Beach, on Coney Island, to Locust Grove, about three miles. From Locust Grove it will run steamboats to New York, making a new line to Coney Island.

**New York Central & Hudson River.**—The passenger trains on this road are now running regularly, the late snow-blockade being entirely removed. The freight traffic is somewhat embarrassed, however, by the number of abandoned freight trains on the freight track, which will require some time to clear out. There were said to be, at the close of last week, 7,000 freight cars snowed in between Albany and Buffalo. As an example of the difficulties attending the clearing of the road, the Syracuse Standard says: "The DeWitt yards are yet full of freight cars, and what is of far more consequence and anxiety, the entire yard is filled with snow. And it is packed underneath the cars and around the wheels from three to four feet deep. 'Heaven alone knows when we will get out of this,' said a railroad man yesterday. 'If we get this thing shoveled out in a month I shall be satisfied.' One of the freight tracks from DeWitt to the Oswego junction, north of the city, is filled with freight cars a distance of five miles."

**New York & Oswego Midland.**—The Utica (N. Y.) Herald announces by authority that the negotiations between the first-mortgage bondholders and the holders of Receivers' certificates of the New York & Oswego Midland Railroad Company have been brought to a satisfactory conclusion. The agreement provides for a sale of the mortgaged property, its purchase by the committee, and the organization by it of a new company. The committee consists of C. A. Jordan, Henry Amy, F. P. Jones, Edward Livingstone, Theodore Houston, Edward Parsons, William H. Fenner, Jr., O. S. Williams and William C. Whitney. Six million dollars in bonds and \$1,200,000 in certificates have already been deposited with the committee. The committee has determined to withdraw the appeal in the foreclosure suit now pending in the Supreme Court of the United States, at Washington, and to procure the entry in the case of a moderate decree.

**Northern Pacific.**—The Purchasing Committee gives

notice as follows: "Under the plan of reorganization, ratified by the decree of the Court, the time in which bondholders should be allowed to participate in the benefits of the plan, by the conversion of bonds into preferred stock, was left to the discretion of the Purchasing Committee. More than three years having passed since this right was given, and more than nine-tenths of the bondholders having converted their bonds, the Committee, desirous of closing their labors, hereby give notice that the right of converting bonds and receiving preferred stock will terminate on the 30th day of June, 1879."

"Circulars giving information how the conversion is made can be had at the office of the Northern Pacific Railroad Company, No. 23 Fifth avenue, New York. The original stock can be exchanged for stock under the plan up to the same time."

**Pittsburgh, Virginia & Charleston.**—At the recent annual meeting the following statement was submitted for the year 1878:

	1878.	1877.	Inc. or Dec.	P. c.
Gross earnings.....	\$135,980	\$129,019	L. \$6,960	5.4
Expenses.....	83,670	90,910	D. 7,240	8.0
Net earnings.....	\$52,299	\$38,109	L. \$14,190	37.2
Gross earn. per mile.....	4,532	4,301	L. 231	5.4
Net ".....	1,743	1,270	L. 473	37.2
Per cent. of exps.....	61.52	70.47	D. 8.95	12.7

It was stated that the extension to Brownsville would probably be built soon.

**Rome, Watertown & Ogdensburg.**—Through travel over this road was resumed Jan. 13, after two weeks, blockade by snow, and some of the branches were obstructed for a day or two longer. The continued snow-fall and high winds filled up the cuts as fast as they were cleared, and at exposed points work had to be given up until the weather moderated. The loss to the road must have been considerable from delay and stoppage of traffic, besides the cost of clearing the tracks.

**St. Louis, Iron Mountain & Southern.**—The following summary is given by the Commercial and Financial Chronicle of the new scheme presented to the stock and bondholders:

"The points of material interest in the agreement for funding, etc., are as follows:

"The agreement is dated Nov. 27, 1878, and subscribed by five sets of parties, viz.: the holders of mortgage bonds; the holders of stock; Robert Lenox Kennedy, Samuel G. Ward, Thomas Allen, Nelson M. Beckwith and Charles H. Marshall, the trustees of the stock trust; the Farmers' Loan & Trust Co.; and the St. Louis, Iron Mountain & Southern Railway Co.

"It is recited that the company intends to pay in full the coupons maturing on and after July 1, 1879, on the several classes of defaulted divisional mortgage bonds, viz.: the St. Louis & Iron Mountain second-mortgage bonds, the Arkansas Branch bonds, the Cairo, Arkansas & Texas bonds, and the Cairo & Fulton first-mortgage bonds; but that only one-half of the interest on these bonds maturing on and prior to June 1, 1879, will be paid in cash.

"The subscribing bondholders agree to deposit with the Union Trust Co. the funded interest certificates and unpaid coupons belonging to their mortgage bonds, and to receive in exchange therefor first-preferred income bonds, bearing 7 per cent. interest, payable annually on March 1, out of the net surplus income of the preceding calendar year, and maturing at the same date as the bonds for the arrears in interest on which they are issued. The interest on these first preferred income bonds is to be payable after the interest on the several divisional mortgage bonds, and to be accumulative; the interest certificates and coupons for which they are issued are not to be canceled, but held as security for the execution of the agreement as specially provided.

"The subscribing bondholders who hold consolidated mortgage bonds agree to deposit them with the Union Trust Co., and to receive in exchange therefor second-preferred income bonds, bearing 6 per cent. interest, payable annually out of the net surplus income remaining after the payment of all interest due on the first preferred income bonds, and accumulative. The consolidated mortgage bonds are not to be canceled, but kept as security for the execution of the agreement as specially provided.

"The subscribing stockholders agree to transfer their stock to the trustees, who shall have the absolute right to vote upon the same until one year after the period subsequent to March 1, 1880, when the company shall have paid the full interest due and accumulated on said first and second-preferred income bonds, provided also that the company shall pay punctually the full amount of interest accrued during that year on such bonds."

"The instrument will not be binding upon the subscribers thereto unless, before Jan. 10, 1879, it shall have been subscribed by the holders of at least 80 per cent. of the outstanding coupons and certificates for which first-preferred income bonds are to be issued by the holders of at least 90 per cent. of the consolidated mortgage bonds, and by the holders of at least 80 per cent. of the capital stock, nor unless such amounts of interest certificates, coupons, bonds and stock certificates are actually deposited with the trust companies before Jan. 25. Provision is made, however, that the trustees may extend the time to a date not later than March 1, 1879, and may reduce the subscriptions required to an amount not less than 75 per cent. of the outstanding coupons and certificates, 90 per cent. of the consolidated mortgage bonds, 75 per cent. of the stock, with like effect as if such reduced amounts and extended time had been those originally provided. When by the execution of the conditions of the agreement it shall have become binding upon the subscribers thereto in the required amounts, the pending suit to foreclose the consolidated mortgage will be discontinued."

The list of directors proposed to be elected stands as follows: Thomas Allen, Samuel G. Ward, H. G. Marquand, Henry E. Pellet, Joseph S. Lowrie, N. M. Beckwith, Henry Whelen, C. H. Marshall, R. B. Minturn, G. S. Morison, Lucius Tuckerman, R. J. Lackland and Ethan A. Hitchcock.

**St. Louis, Lebanon & Western.**—This projected road is to run from Lebanon, Mo., on the St. Louis & San Francisco, nearly due west to Wichita, Kan., a distance of about 275 miles. The eastern part will be nearly on the line of the projected Laclede & Fort Scott road, where there is some graded road-bed that can be used. It is said that the people along the line are ready to grade and tie the road, and that iron and equipment can be provided by a mortgage for \$8,000 per mile. St. Louis people are to be asked to take half the bonds, the other half to be placed in New York.

**Salem & Lowell.**—At the annual meeting, held Jan. 8, the stockholders voted to renew or extend the existing mortgages on the road for 20 years; to ratify the new lease to the Boston & Lowell, which extends the existing lease for 20 years, from Oct. 1, 1878; finally to instruct the directors to petition the Legislature for authority to consolidate with the Boston & Lowell and the Lowell & Lawrence companies.



**Tennessee Railroad Debts.**—The message of Governor Porter, of Tennessee, to the Legislature says: "Since the adjournment of the Fortieth General Assembly, the debt of the Memphis & Charleston Railroad, amounting to \$1,617,916; that of the Mississippi & Tennessee Railroad, amounting to \$316,774; the balance due from purchasers of the Knoxville & Charleston Railroad, amounting to \$51,125, and that of the Mississippi Central Railroad, amounting to \$1,199,180, have been paid in the hands of the state, and the same have been cancelled in pursuance of law. I transmit the report of R. P. Neely, Receiver of the Mississippi Central Railroad. This receivership cost the state nothing. It required the purchaser to pay all the expenses of operating the road while it was in the custody of the state."

**Union Pacific.**—Land Commissioner L. Burnham reports for the year 1878 sales of 318,903.47 acres of land for \$1,557,082.32. The average price per acre was \$4.88; number of purchasers, 3,711, making an average of \$5.93 acres to each one.

**Wabash.**—It is reported that the negotiations between this company and the Illinois Central as to the line between Chicago & St. Louis have come to an end, the Central refusing to accept the terms offered by the Wabash for the use of it line.

**Wabash & Erie.**—This company has filed articles of incorporation in Indiana to build a narrow-gauge road along the line of the Wabash & Erie Canal. The capital stock is to be \$1,000,000.

**Wisconsin Central.**—A dispatch from Milwaukee, Wis., Jan. 14, says that the trustees under the first mortgage have taken formal possession of the road. This action is taken in consequence of suits begun by holders of bonds, who have sued the company and seriously embarrassed it by injunctions, attachments and similar proceedings. The complications have been further increased by the suit recently begun by the Trustee under the mortgage of the leased Milwaukee & Northern road. The Trustees state, in taking possession, that the affairs of the company are in a promising condition, and they believe that, with freedom from vexatious litigation, all creditors can be protected and finally paid.

#### ANNUAL REPORTS.

##### Philadelphia & Reading.

The following statements are from the report of President Franklin B. Gowen for the fiscal year ending Nov. 30, 1878. The detailed reports and tables are not yet published.

No change is noted in mileage worked, which consists of 98.4 miles main line; 228.6 miles of branches owned; 416.4 miles of branches leased and 56.4 miles controlled, making 799.8 miles in all.

The earnings and expenses for the year were as follows:

	1878.	1877.	Inc. or Dec.	P. c.
Travel.....	\$1,523,423	\$1,010,040	D.	\$513,383 5.2
Merchandise.....	2,690,706	2,913,588	D.	222,882 7.6
Coal.....	7,206,952	7,505,207	D.	298,255 4.0
Mail.....	41,665	41,587	I.	78 0.2
Miscellaneous.....	73,787	72,478	I.	1,309 1.8
Gross receipts.....	\$11,539,593	\$12,142,910	D.	\$603,317 5.0
Gross expenses.....	7,319,306	7,751,693	D.	432,387 5.6
Net profits.....	\$4,220,287	\$4,391,217	D.	\$170,930 3.9
Gross earn. per mile.....	14,424	15,179	D.	755 5.0
Net earn. per mile.....	5,275	5,489	D.	214 3.9
Per cent. of exps.....	63.4	63.8	D.	0.4 0.6

Receipts and expenses per passenger and per ton, including renewal fund, rents and taxes, were as follows, in cents:

	1878.	1877.		1878.	1877.
	Receipt.	Cost.	Net.	Receipt.	Cost.
Per passenger.....	23.9	17.5	6.4	24.1	16.6
P. ton of merchandise.....	97.6	67.3	30.3	102.7	63.8
Per ton of coal, including tonnage of main line and br's only.....	148.9	89.7	59.2	127.1	81.8
Per ton of coal, including tonnage of laterals also.....	122.0	73.5	48.5	103.4	66.6

This includes all charges except interest on funded debt. Including only the actual working expenses of the road, the results would be as follows:

	1878.	1877.		1878.	1877.
	Receipt.	Cost.	Net.	Receipt.	Cost.
Per passenger.....	23.9	13.2	10.7	24.1	12.2
P. ton of merchandise.....	97.6	49.4	48.2	102.7	44.9
Per ton of coal, including tonnage of main line and br's only.....	148.9	62.5	86.4	127.1	58.3
Per ton of coal, including tonnage of laterals also.....	122.0	51.2	70.8	103.4	47.5

As condensed from the transportation and income accounts the result of the year's business is stated as follows:

Receipts over cost of working the road.....	\$4,220,227.15
Profit on steam colliers.....	232,425.58
Balance of sinking fund, consolidated mortgage, year 1878, not used.....	199,364.45
Total.....	\$4,652,017.18
Less depreciation, drawbacks, loss on coal barges, etc.....	186,624.82
Balance.....	\$4,465,392.36
Loss on Schuylkill Canal, less profits of Transportation Line.....	\$98,682.51
Loss on Susquehanna Canal.....	179,929.79
Total.....	278,612.30
Balance.....	\$4,186,780.06
Interest on bonded debt for the year.....	\$4,576,576.54
Interest on bonds and mortgages.....	111,694.74
Debit balance of interest account.....	330,559.12
Total.....	5,018,830.40
Debit balance to profit and loss.....	\$832,047.34

This result is obtained by charging full interest and rentals, but of the amount thus charged \$1,798,062 were payable in scrip. Using this amount, the following results are obtained:

Interest and rentals payable in scrip.....	\$1,726,062.00
Deduct loss as above.....	\$32,047.34
Cash surplus earnings for the year.....	\$894,014.66
Funds advanced to Coal & Iron Co. to pay interest.....	\$1,088,086.46
Less scrip for interest on debenture loan.....	121,170.00
Balance.....	\$966,916.46
Losses of Coal & Iron Co. for the year.....	752,049.14
Total.....	1,718,965.60
Balance, cash deficit of the two companies for the year.....	\$24,950.94

The report says: "This cash deficit has been supplied by withholding for three months the salaries and wages due to the officers and employees of the railroad company, which arrears have recently been liquidated by payments in wages

certificates, the amount of which outstanding practically represents a loan from the employees of the company to enable the latter to meet the cash deficit in its operations for the year.

"The condition of the floating debt of the two companies, including therein certain items of bills receivable discounted, to which reference was made at the last report, has been, at the several dates mentioned, as follows:

On Nov. 30, 1877.....	\$6,320,329.46
On Dec. 31, 1877.....	6,562,775.82
On Jan. 31, 1878.....	6,716,273.06
On Feb. 28, 1878.....	6,812,707.73
On March 31, 1878.....	7,308,145.06
On April 30, 1878.....	7,004,822.04
On May 31, 1878.....	6,890,164.33
On June 30, 1878.....	7,400,241.96
On July 31, 1878.....	7,793,004.11
On Aug. 31, 1878.....	7,422,311.32
On Sept. 30, 1878.....	7,152,015.42
On Oct. 31, 1878.....	6,776,748.68
On Nov. 30, 1878.....	6,419,003.38

"Owing to the failure of the recent association of coal companies to secure for coal a sufficiently increased price to compensate for the great loss of tonnage sustained by the company in consequence of the restrictions imposed by the association, the anticipations formed last year of profits to result from the coalition have not been realized, and the managers have not only been unable to make any reduction of the floating debt, but its volume has been increased by the amount represented by wages certificates now outstanding. As the several stoppages of mining resulting from the restrictive policy of the coal association deprived the company of its accustomed daily and weekly receipts from coal traffic, it was found impossible to pay the employees promptly, and at the close of the year there was due and unpaid for September, October and November the sum of \$983,141.59; as there seemed to be no reasonable probability of being able to overcome these arrears until after the opening of the spring trade, it was considered best to issue therefor wages certificates in sums of \$10 each, bearing interest from Dec. 16, payable one-half on April 15 and one-half on May 15, and all receivable at any time for any debt due to either company. These certificates have been very favorably received by the employees and the public; they are generally taken in business transactions at par, and are readily sold for cash at but a trifling discount; and when a few weeks' interest upon them has accrued, it is not doubted that they will command a premium. The total amount of them issued up to Jan. 11 has been \$701,520, of which there have been already received and canceled, in payment of debts due to the company for freights, tolls, tickets and coal, the sum of \$183,810, leaving outstanding the sum of \$517,710, to which must be added of ordinary floating debt due Jan. 11, 1879, the sum of \$6,710,513.91 as compared with the amount, \$6,674,980.52, due on Jan. 12, 1878, and referred to in the last annual report.

"In accordance with the resolution adopted at the last annual meeting, the sum of \$1,309,765.53, representing that amount of the bonds of the company canceled by the operations of the sinking funds previously charged against the net income of the company, has been used to reduce the amount standing in the balance-sheet to the debit of profit and loss. In addition to this amount, the sum of \$199,364.45, being the unappropriated balance charged net income in the year 1878 for the sinking fund of the consolidated mortgage loan, has been credited back to income account, and will no longer appear on the balance-sheet."

The following statement shows the condition of the scrip and income mortgage bond account at the end of the year, and gives the amount of each issued during the year:

	Debiture and guaranty scrip.	Gen. mort- gage loan scrip.	Perkiomen R. R. scrip.	Total.
Total amount to be issued.....	\$9,284,475	\$1,771,740	\$101,250	\$8,157,465
Issued to Nov. 30, 1878.....	5,519,407	1,716,300	97,110	7,332,817
Less received with freight bonds.....	2,370			2,370
Balance.....	\$5,517,037	\$1,716,300	\$97,110	\$7,330,447
Converted into income mortgage bonds.....	2,041,140	4,860		2,046,000
Outstanding Nov. 30, 1878.....	\$3,475,897	\$1,711,440	\$97,110	\$5,284,447
Scrip issued in year ending Nov. 30, 1878.....	953,091	271,350	10,980	1,235,421
Income mortgage bonds issued during year ending Nov. 30, 1878.....	238,140	4,860		243,000

The only other change in the capital accounts during the year has been caused by the redemption of \$6,500 of the debenture freight bonds of 1868-93, received, according to the terms thereof, in payment of freight.

The volume of traffic for four years is shown as follows:

	1878.	1877.	1876.	1875.
Passengers carried.....	6,376,413	6,674,889	10,936,157	6,638,129
Tons coal, 2,240 lbs.....	5,909,140	7,255,318	5,595,207	5,505,455
Tons merchandise, 2,000 lbs.....	2,757,839	2,837,648	2,493,277	2,720,208
Tons company's material, 2,000 lbs.....	412,110	313,981	482,222	581,984
Total tonnage (2,000 lbs.) including weight of passengers.....	10,319,853	11,833,826	10,236,326	10,069,040

The report says: "There is but little to report with reference to the various leased lines, except that, as against last year, the Catawissa Railroad shows a falling off in net earnings of \$103,210.84, and the Philadelphia, Germantown & Norristown Branch a decrease of \$51,006.93. The Perkiomen Railroad shows an increase of \$4,436.78, and the Lancaster & Quarryville Railroad, shows a decrease of \$19,662.60.

"The profit from the Express Department for the year is \$52,335.73, as against \$55,181.13 for 1877 a result which is entirely satisfactory, considering the general depression of express traffic during the year and the exceptional stagnation prevailing in the coal region due to the reduced output of coal.

"The steam colliers have made a net profit for the year of \$232,425.58, after charging for insurance fund, \$72,300. The first loss of the line occurred during the year in the total wreck of the steamer Leopard, on June 13 last, upon Londoner Ledge, near Rockport, Mass. The Leopard was built in 1870, at a cost of \$104,979.36. During her eight years of service she had earned \$64,780.09, and, in addition thereto, had contributed to insurance fund \$28,610.56; making a total of \$93,390.65. Her entire cost has been charged off to insurance fund, which is still in credit \$216,137.18."

The usual statement of rail renewals is given. There were 6,728 tons of worn-out rails replaced last year, and the total product of the rolling mill was 10,227 tons. The rails made by the rolling mill and laid in various years have

been worn out and replaced as follows: 57.4 per cent. of those laid in 1868; 34.8 per cent. of 1869; 31.1 of 1870; 20.1 of 1871; 19 of 1872; 21 of 1873; 13.7 of 1874; 13.1 of 1875; 4.4 of 1876; 1.5 of 1877, and 0.014 per cent. of those laid in 1878.

#### COAL & IRON COMPANY.

The total coal tonnage of this company has been as follows:

	1878.	1877.	Decrease.	P. c.
Mined by company.....	2,727,608	3,794,529	1,066,921	28.1
" tenants.....	1,100,181	1,389,108	288,927	20.8
Total.....	3,827,789	5,183,637	1,355,848	26.2

The income account of the company for the year was as follows:

Rents of coal lands, lands and houses.....	\$394,986.68
Coal sales.....	7,793,203.14
Iron ore and miscellaneous.....	61,888.17
Total receipts.....	\$8,192,077.99
Total expenses.....	8,648,314.92
Net loss.....	\$456,236.93
Add loss on inventories, bad debts, etc.....	205,812.21
Total charge to profit and loss.....	\$752,049.14

The expenses include \$4,001,363.49 paid the Railroad Company for tolls and freight on coal. The report says:

"As compared with last year, it will be seen that with a reduced output of 1,355,848 tons, the company lost, after making allowances for depreciation and bad debts, \$752,049.14, as against \$755,478.37 for the previous year.

"The total interest account of the Coal & Iron Company, other than that due the Railroad Company, for the year, was \$1,088,086.46.

"Of which there was payable in scrip for the debenture loans \$121,170. \* \* \*

"The actual cost of mining and delivering coal into the railroad cars for the year was 123.7 cents as against 103.9 cents for the previous year, an increase of 19.8 cents, of which about eight cents was caused by the payment of such increased wages as were due under the sliding scale to the increased price of coal and higher rates of toll and transportation, and the remainder, 11.8 cents per ton is due entirely to the decreased production, necessitating the division of certain total fixed expenses by a greatly diminished production.

"The result of the year's business, due to the restriction of tonnage imposed by the associated companies, and as affecting the present and future financial condition of the company, is such as to merit the serious consideration by the shareholders of the question of the policy of remaining in an independent position, or of joining in any association with the other companies for the improvement and protection of the trade, if such association should again be proposed.

"The recent association expired by its own limitation on Dec. 31, but the benefits which it was hoped the restrictive policy of the spring and summer would enable its members to reap in the fall were not realized, partly in consequence of the refusal of the Lehigh Valley interest to ratify the agreement of all the other parties to extend the term of the association over the winter, but principally on account of the very general belief that the Lehigh Valley interests would act independently after the expiration of the year, a belief which was converted into a certainty by the neglect or refusal of any of the shippers over the Lehigh Valley Railroad, including the Lehigh Valley Coal Company, to attend or be represented at a meeting held in New York on December 27th last, to consider the question of future association, and at which delegates from all other interests in the trade were present. With the prospect of the termination of the association and a return to lower prices, which, with over-production, inevitably attend open competition, all dealers and purchasers bought from hand to mouth, as every prudent merchant or manufacturer was anxious to avoid carrying a stock of coal into a falling market. It is no exaggeration to say that the direct loss to the trade by the refusal of the Lehigh Valley interests to ratify the agreement of their representative to continue the association through the winter has been at least \$3,000,000, of which large amount each party to the association probably lost in the proportion of its quota of tonnage.

"The injuries suffered by the company owing to the combination of last year, as compared with its independent position of the previous season, were—an increase in the cost of mining coal; a large decrease in the railway receipts from merchandise and passengers, owing to diminished output of coal; an increase of accidents in mining, due to the condition of the mines being affected by the frequent suspensions of mining; an unsettled feeling of discontent among the miners and laborers in the coal fields, due to want of employment, which was not at all compensated by the increase of wages; a feeling of opposition among iron and other manufacturers at the frequent interruption of mining, resulting in a disposition to resort to other fuels rather than submit to arbitrary interference with the regularity of their accustomed supply of anthracite; an absolute failure to realize in increased prices for coal, or increased rates of transportation, sufficient to overbalance the increased cost due to restricted production. All involving a loss of net profits to the two companies, as compared with the previous year, of \$382,173.96.

"On the other hand, the benefits resulting from the combination have been the actual consumption of all surplus coal and the ability to secure fair prices in the future, which it was impossible to obtain so long as the large production kept the market overstocked. It follows, therefore, that if the company could obtain its proper quota of the entire tonnage, and if perfect, good and fair dealing could be secured in any future compact between the several interests, this company would have nothing to lose by continuing as a member of any properly-organized association. It must be confessed, however, that the manner in which previous compacts have been kept by one of the parties, rather than the act of association itself, causes the managers to distrust any future agreement that is not amply protected in all the essential parts in which the last two have unfortunately proved defective.

"In open competition for the market, with the admitted excellence and great variety of Schuylkill coal and no restrictions imposed upon production, the managers have no fear of the ability of the company to meet all of its cash fixed charges; but they cannot contemplate without a shudder the prospect of again tying their hands by agreements such as those made in 1876 and 1878, under which it was in the power of one interest to render abortive any attempt to secure increased profits, and they would be guilty of gross mismanagement if they consented to any further restriction of production that was not accompanied by practical and effectual guarantees that the reduced output should yield at least as great a profit as the increased quantity which could be mined and transported in open competition."

A table is appended showing the monthly coal shipments and the tonnage of both companies, with the net result (profit or loss) of the joint business for each month, concerning which the report says:

"The fact that in the month of September, usually one of



the best of the year, with a railroad tonnage of 327,000, of which 190,000 was mined by the Coal & Iron Company, at a cost of \$1.49½ cents per ton, the two companies actually lost \$7,522.43, while in the month of November (the only one during the year when full time was made), with a total tonnage of 803,807 tons, of which the Coal & Iron Company mined 378,590, at the low cost of 92 cents per ton, the two companies made \$956,283.03 net profit, after payment of all rentals, renewal fund and all charges, except interest, will show more forcibly than can be well expressed in words the danger attending another arbitrary restriction of tonnage.

In the present depressed condition of the coal trade, the aim of the company has always been to keep its property and plant at all times in good condition for effective production, so as to take advantage of the return of prosperity to earn enough to wipe off the score that has accumulated during the last three years.

#### FINANCIAL PROSPECTS.

The report further says: "Three years of ordinary earnings, in fair times, would enable the company to resume dividends; but it must be remembered that, in addition to its earnings, the company has a large amount of most valuable securities which it could part with, and which, at the proper time, could be made use of, either to pay the floating debt or to retire the scrip and income bonds."

A statement in detail is given of some of these securities, chiefly stocks and bonds of leased lines, amounting in all to \$5,059,050, paying in all a yearly income of \$339,200. (It may be noted that the value of these securities is in a great measure dependent upon the solvency of the Reading Company itself.) The report continues:

"So long as the present depression continues, it has not been thought advisable to present any scheme looking to the final extrication of the company from financial difficulties, but upon the return of prosperity and the demonstration of the ability of the company to earn, in addition to its fixed charges, enough for a reasonable dividend upon its shares, it is not doubted that sufficient money can readily be raised in the form of additional capital to liquidate the floating debt, in which event some of the securities in the above list, together with the \$5,000,000 of unused general mortgage bonds, could be used to retire the scrip and income bonds, and when this is accomplished all the earnings over fixed charges could at once be distributed to the shareholders. In the meantime the managers anticipate no difficulty in carrying along the floating debt, which is now all abundantly secured by good collaterals; and feeling secure of their ability to meet all cash fixed charges. If there is no restriction of coal tonnage, they do not propose to surrender the independent position of the company to become a member of any new coal association, without receiving practical guarantees that it will be to the advantage of the company to do so."

The rest of the report is taken up with a statement of the reasons for the failure or non-action of the investigating committee of stockholders appointed last year, and an explanation of the affairs concerning which the charges of Ex-President Smith were made, and which the committee was to investigate.

#### Boston & Lowell.

This company owns a line, all double track, from Boston to Lowell, 26.75 miles, with five branches, 19.21 miles in all; it leases the Lowell & Lawrence, 13 miles, the Salem & Lowell, 16 miles, and the Middlesex Central, 7.98 miles, making in all 45.96 miles owned, and 82.94 worked. The whole system and that of the Nashua & Lowell have been worked under one management, and the earnings divided, the Boston & Lowell receiving 69 and the Nashua & Lowell 31 per cent. This arrangement is now ended, as noted below. The report is for the year ending Sept. 30, 1878. The Salem & Lowell and Lowell & Lawrence roads are substantially owned and arrangements are being made to consolidate them with this company.

The balance sheet is as follows:

Stock \$70.714 per mile.....	\$3,250,000.00
Bonds (\$53.296 per mile).....	2,449,500.00
Notes payable.....	285,000.00
Lowell & Lawrence and Salem & Lowell R. R.....	75,340.00
Coupons and dividends unpaid and October coupons.....	64,122.61
Profit and loss.....	453,611.51
<b>Total.....</b>	<b>\$6,577,574.12</b>

Construction and equipment (\$109,275 per mile).....	\$5,022,295.38
Leased lines equipment.....	51,984.00
East Cambridge and Mystic Wharf properties.....	535,339.20
Leased lines accounts.....	407,174.00
Nashua & Lowell joint accounts.....	157,145.94
Sinking and insurance funds.....	207,744.54
Cash, receivables and materials.....	195,890.46
<b>Total.....</b>	<b>\$6,577,574.12</b>

During the year the bonded debt was increased \$325,000, and \$122,000 notes payable were retired.

The work reported is as follows:

Train mileage:	1877-78.	1876-77.	Inc. or Dec.	P. c.
Passenger.....	531,044	527,938	I.	3.106
Freight.....	412,713	411,889	I.	844
<b>Total.....</b>	<b>943,757</b>	<b>939,827</b>	<b>I.</b>	<b>3,950</b>
Passengers carried.....	1,935,843	1,941,787	D.	5,944
Tons freight carried.....	604,122	568,430	I.	35,692

The earnings for the year were as follows:

	1877-78.	1876-77.	Inc. or Dec.	P. c.
Passengers.....	\$470,307.08	\$506,967.56	D.	\$36,660.48
Freight.....	\$72,240.23	\$87,916.42	D.	\$15,676.19
Mail and Exp.....	\$28,798.04	\$1,477.73	D.	\$2,670.69
Accumulation of sinking funds.....	9,655.24	11,407.78	D.	1,752.54
<b>Total.....</b>	<b>\$1,081,060.59</b>	<b>\$1,137,769.49</b>	<b>D.</b>	<b>\$56,802.90</b>
Expenses.....	761,538.48	789,762.28	D.	28,223.80

Net earn.....	\$319,528.11	\$348,007.21	D.	28,479.10
Gross earnings per mile.....	13,034.32	13,717.90	D.	683.57
Net earnings per mile.....	3,852.52	4,195.80	D.	343.27
Per cent. of ex.....	70.44	69.41	I.	1.03

The result of the year was as follows:

Net earnings.....	\$319,528.11
Interest.....	\$116,349.81
Rentals.....	94,718.12
Dividend, 2 percent.....	65,000.00
<b>Total.....</b>	<b>\$276,067.93</b>

Balance.....

Balance.....	\$43,466.18
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A new iron coal shed has been built at East Cambridge. Commodious entrances have been made in the front of the Boston passenger depot. A new iron bridge is being built over Gorham street in Lowell. The cut through the ledge at Lowell is being widened to permit the construction of a new train house. The freight bridge to the East Cambridge yard has been widened to allow four tracks along its whole length. The Mystic Wharf is now in full use and pockets for storing coal have been built. The bridges and other preliminary work on the extension of the Lowell & Lawrence road in Lawrence are finished. Arrangements have been made to extend the Middlesex Central road some three miles to the Framingham & Lowell at Concord Prison.

Concerning the contract with the Nashua & Lowell the report says:

"The contract for the joint operation of the Boston & Lowell and Nashua & Lowell railroads, which commenced Oct. 1, 1868, expired by its own limitation on Oct. 1 last. During its existence the directors have repeatedly called attention to what they believed to be its favorable operation for both corporations, and in accordance with the views of the stockholders, as expressed at the last annual meeting, they have exhausted every reasonable endeavor for the continued identification of the two interests. Even a moderate regard for economy and efficiency seemed to forbid that two railroads, the one 26 and the other 14 miles in length, and forming part of a through-line, should be operated separately and of necessity to a greater or less extent antagonistically. In prosperous times such action could not be justified, and in this period of business depression it can exist only in disregard of the plain interests of the stockholders of one or both of the corporations. The upper connecting roads of the through line were also directly interested in the continuance of our joint operation. To them a separation involved double negotiation in entering into business contracts, and required separate accounts and separate settlements with each corporation. Before the expiration of the joint contract, therefore, your directors proposed (subject to the approval of the stockholders) to take a lease of the Nashua & Lowell Railroad for 99 years, at an annual rental of 6½ per cent. upon the capital of \$800,000; to pay all taxes and to assume the entire rental and operation of their leased roads; to purchase at existing cost the interest of the Nashua & Lowell Railroad in the corporation warehouses in Boston and the Mystic property at Mystic; to assume the liability of the claims against the Peterborough Railroad, amounting to \$105,000, and the \$60,000 advanced to the Manchester & Keene Railroad. This offer was made with a full appreciation of the fact that such rental was more than present earnings could justify. It was based upon the idea of a probable increase of future earnings under a long lease, and the avoidance of useless expense and all conflict of interests. This offer was accepted by a majority of the directors, and afterward declined, and on the 1st day of December the two roads went under separate management. Considerable progress has been made in the division of the rolling stock and personal property, which is owned in the proportion of 69 to 31 per cent, and no great trouble is anticipated in perfecting such division."

"While the directors express their regret at what they conceive to be an unnecessary expense, they feel entire confidence in the capacity of this corporation to attract, by its superior facilities, its full share of the public patronage, and in its ability with efficient and economical management to fully protect its interests and make a fair return to its stockholders."

#### Northeastern (South Carolina).

This company owns a line from Charleston, S. C., northward to Florence, 103 miles. It is equipped with 13 engines; 13 passenger and 5 mail and baggage cars; 87 box and 55 platform cars. The report is for the year ending Sept. 30, 1878.

The general account is as follows:

Common stock.....	\$890,350.00
Preferred stock.....	88,000.00
<b>Total stock (\$9.080 per mile).....</b>	<b>\$987,350.00</b>
Bonded debt (\$10.027 per mile).....	1,084,000.00
Certificates of indebtedness and interest outstanding.....	59,180.71
Profit and loss.....	108,234.70
<b>Total.....</b>	<b>\$2,238,765.47</b>

Road and equipment (\$21,000 per mile).....	\$2,148,130.65
Stocks owned.....	17,301.46
Assets, real estate, receivables, cash, etc.....	73,333.36
<b>Total.....</b>	<b>\$2,238,765.47</b>

The bonded debt consists of \$890,000 first-lien 8 per cent. bonds; \$234,000 second-lien 8 per cent. bonds; \$2,000 old bonds never presented for payment and \$28,000 real estate bonds. There are also \$68,000 second-lien bonds held by trustees as security for the same amount of preferred stock. The company is endorser on \$40,000 first-mortgage 8 per cent. bonds of the Ashley River Railroad. The account shows a decrease of \$30,836.33 in liabilities and a gain of \$19,557.57 in assets.

Some traffic statements are as follows:

	1877-78.	1876-77.	Inc. or Dec.	P. c.
Locomotive mileage.....	2,250	38,827	I.	6.386
Passengers carried.....	45,216	86,088	I.	11,872
Bales cotton carried.....	78,590	133,385	D.	679
Barrels naval stores.....	132,706	133,385	D.	679

Locomotive service cost 15.91 cents per mile. The average mileage was 20,968 miles per engine; highest reported for one engine, 34,842 miles. Two engines are rebuilding and made very little mileage.

The earnings for the year were as follows:

	1877-78.	1876-77.	Inc. or Dec.	P. c.
Passengers.....	\$83,531.61	\$72,503.85	I.	\$11,027.76
Freight.....	295,607.66	233,662.46	I.	31,945.20
Mails.....	14,505.55	13,905.00	I.	600.55
<b>Total.....</b>	<b>\$393,644.82</b>	<b>\$320,071.31</b>	<b>I.</b>	<b>\$73,573.51</b>
Expenses.....	201,144.38	192,038.37	I.	9,106.01

Net earnings.....	\$192,500.44	\$128,032.94	I.	\$64,467.50
Gross earnings per mile.....	3,565.15	3,140.60	I.	424.55
Net earn. per mile.....	1,253.14	1,255.22	I.	37.08
Per cent. of ex.....	55.31	60.01	D.	4.70

The income account was as follows:

Net earnings.....	\$192,500.44
Interest.....	\$97,683.43
Back taxes, old claims, etc.....	7,089.21
Extraordinary expenses, improvements, etc.....	7,334.00
<b>Total.....</b>	<b>\$304,606.08</b>

Surplus for the year.....	\$50,393.80
Balance of profit and loss, Sept. 30, 1877.....	57,840.96
<b>Balance, Sept. 30, 1878.....</b>	<b>\$108,234.76</b>

During the year the road-bed, bridges and trestles were much improved; 594 tons steel and 68 tons new iron rails were laid, and 650 tons more of steel rails have been laid since its close. Two engines are being rebuilt and the cars have had thorough repairs.

The company has, as far as possible, resisted the tendency of connecting and parallel lines to excessive competition and extremely low rates.

The report says: "Under a joint agreement between the Savannah & Charleston, the Ashley River and the Northeastern railroad companies, the former, for and in consideration of its use of the respective tracks of the latter, guarantees to the Ashley River Railroad Company a monthly interest of eight per cent. on the cost of its road (say \$48,000) its taxes, and a bonus of \$60 per month, all to be equal at least to \$860 per month, payable monthly, and to the Northeastern Railroad, its proportion of one-half of the revenue derived from the use of its track according to its distance, with a monthly sum (at present of \$168.67) for certain depot facilities, to be afforded them at Charleston."

"This arrangement has, so far, worked satisfactorily, and

to the advantage, we think, of both parties. To supply the Savannah & Charleston road the necessary accommodations has cost us about \$4,500, while between the 1st of January last and the 30th of September, we have received from it the sum of \$6,448.49."

#### New York, New Haven & Hartford.

This company owns a line from Williamsbridge, N. Y., to Springfield, Mass., 123 miles, with branches from Berlin, Conn., to Middletown, 10 miles; from Berlin to New Britain, 3 miles; from Windsor Locks, Conn., to Suffield, 4.5 miles, and in Hartford, Conn., one mile, making 141.5 miles owned. It leases the Harlem River & Portchester road, from New Rochelle, N. Y., to Mott Haven, 10.8 miles, and the Shore Line road, from New Haven to New London, 50 miles. The accounts of the Shore Line are kept separately, the figures given being for 153.3 miles worked. Its trains run on the New York & Harlem track from Williamsbridge to the Grand Central Depot in New York, 11 miles. The report is for the year ending Sept. 30, 1878.

The equipment is 93 locomotives; 199 passenger and 59 mail and baggage cars; 1,280 freight and other cars. Two passenger cars were added during the year.

The balance sheet is as follows:

Stock (\$109.541 per mile).....	\$15,500,000.00
Current accounts and balances.....	306,204.02
Contingent account.....	169,261.30
Profit and loss.....	1,449,379.17
<b>Total.....</b>	<b>\$17,924,844.49</b>

Railroad, equipment, real estate, docks and wharves (\$11,187 per mile).....	\$15,733,002.09
Materials and supplies.....	487,538.31
Debit balance, Shore Line.....	197,271.82
Cash, cash assets and receivables.....	1,507,029.27
<b>Total.....</b>	<b>\$17,924,844.49</b>

The company has no funded debt, but is liable as indorser on Harlem River & Portchester bonds, the annual interest on which is \$130,000. Capital expenditure accounts were increased \$39,953.29 for new cars and steam-tug boat.

The earnings for the year were as follows:

	1877-78.	1876-77.	Inc. or Dec.	P. c.
Passengers.....	\$2,241,171.92	\$2,369,262.03	D.	\$158,091.01
Freight.....	1,309,778.08	1,326,707.34	D.	10,929.26
Mails and express.....	268,331.10	212,435.45	I.	55,895.65
Interest.....	35,701.55	15,654.65	I.	20,046.90

Total.....	\$3,855,082.65	\$3,954,060.37	D.	\$101,077.72
Expenses.....	1,941,656.12	2,005,341.30	D.	63,685.18
Taxes.....	226,836.76	217,036.04	I.	9,800.72

Total.....	\$2,108,492.88	\$2,222,377.34	D.	\$113,884.46
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Net earn.....	\$1,684,489.77	\$1,731,683.03	D.	\$47,193.26
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Gross earn. per mile.....	25,133.61	25,792.96	D.	659.35
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Net earn. per mile.....	10,988.22	11,296.04	D.	307.82
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Percent. working expenses.....	50.30	50.72	D.	0.42
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Percent. expts. and taxes.....	56.28	56.20	I.	0.08
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Neither earnings nor expenses include the rental paid for the use of the Harlem track into New York, which was \$228,938.92, or \$30,813 per mile, last year, against \$235,765.88 the previous year. Earnings, especially passenger earnings, show less decrease than might have been expected in view of the extremely sharp competition of the boat lines for the New York-Boston business, and the refusal of the land line to lower rates.

The income account may be expressed as follows:

Net earnings.....	\$1,684,489.77
Interest on Harlem River & Portchester bonds.....	\$130,000
Dividends, 10 per cent.....	1,550,000
<b>Total.....</b>	<b>\$3,364,489.77</b>

Balance.....	\$4,480.77
Increase in accounts payable.....	70,394.87
Decrease in Shore Line debtor balance.....	1,539.43

Total.....	\$82,424.07
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Increase in materials on hand.....	\$4,072.32
New equipment.....	\$9,953.29
<b>Total.....</b>	<b>\$14,025.61</b>

Balance.....	\$38,398.46
Cash and cash assets, Oct. 1, 1877.....	1,488,630.81
<b>Total.....</b>	<b>\$1,527,029.27</b>

The cash and cash assets are made up of \$401,056.71 cash; \$361,086.46 loans and bills receivable; \$223,242.89 accounts and balances due, and \$521,643.21 advances to Harlem River & Portchester road.

The traffic of the year was as follows:

	1877-78.	1876-77.	Inc. or Dec.	P. c.
Train mileage.....	1,385,499	1,401,741	D.	16,242
Passenger.....	702,221	685,600	I.	16,621
Freight.....	33,837	25,989	I.	7,848
Gravel.....	2,121,557	2,113,330	I.	8,227

Total.....	2,121,557	2,113,330	I.	8,227
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Pass. carried.....	3,225,498	3,554,366	D.	328,868
Tons freight car.....	105,458,051	111,641,817	D.	6,183,766
Tons freight car.....	898,789	886,476	I.	12,313

Tonnage mileage.....	45,594,854	39,646,733	I.	5,948,121
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Av. Train load.....	76.12	76.65	D.	3.53
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Passengers, No.....	64.93	57.83	I.	7.10
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Freight, tons.....	64.93	57.83	I.	7.10
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These figures indicate a falling off in through rather than in local traffic, with an increase in the average haul on freight.

The report says: "Your road and equipment have been kept in their usual excellent condition. The tracks of the Main Line from Harlem Railroad Junction to Springfield, of the Shore Line from New Haven to New London and of the Harlem River Branch are now laid with steel rails, except about eight miles, on which steel-capped rails are in use. This condition of the track will, for some years to come, considerably reduce the cost of road repairs, and it is to be hoped, will enable your company to keep its net annual income hereafter from falling below the amount for the past year, even if business shall continue in its present state of depression."

#### SHORE LINE DIVISION.

The earnings and expenses of this road were, for the year:

	1877-78.	1876-77.	Inc. or Dec.	P. c.
Passengers.....	\$225,423.37	\$251,735.18	D.	\$26,311.81
Freight.....	63,166.29	65,742.40	D.	2,576.11
Express, mails, etc.....	29,888.91	24,897.01	I.	4,991.90
<b>Total.....</b>	<b>\$318,478.57</b>	<b>\$342,374.59</b>	<b>D.</b>	<b>\$23,896.02</b>
Expenses.....	216,439.14	202,505.15	D.	13,933.99

Net earnings.....	\$101,539.4
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